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Competitor "C"	8 minutes	cutting edge burnt

Conclusion:

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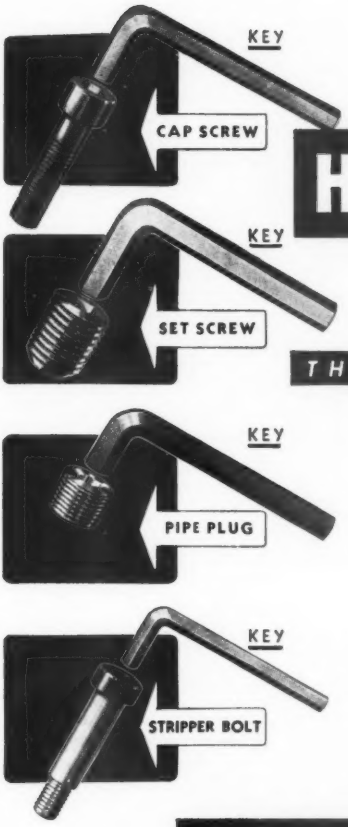

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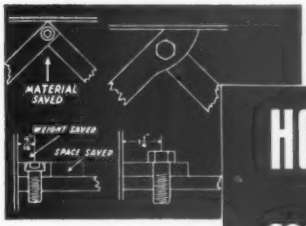

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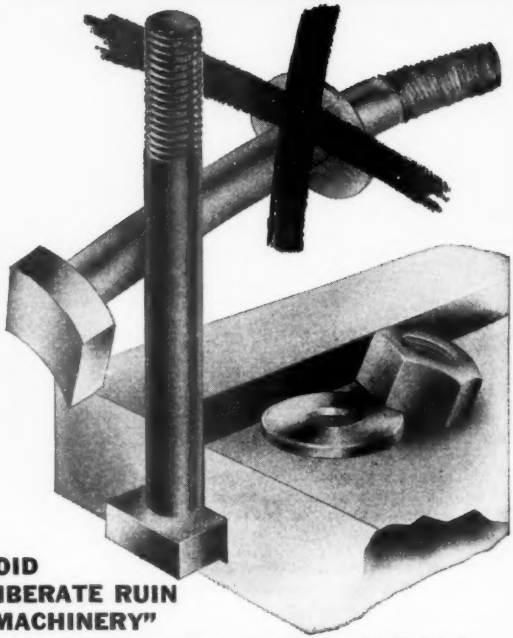

"AVOID DELIBERATE RUIN OF MACHINERY"

"Most metal working machinery is provided with T-slots in Tables for fastening work. In modern production these T-slots are completely finished by milling or planing; consequently every surface is finished smooth and square. But when machines are put in operation, any kind of hodge-podge bolt is used for fastening work. It does not take long to ruin T-slots with such bolts, and after that has happened, a most essential part of the machine is ruined. The cost of proper bolts is very small, and I hope that my observations expressed here will reach the men in authority to *avoid this deliberate ruin of American Machinery.*"

Above is from a letter to Tool Engineer, January 1946.

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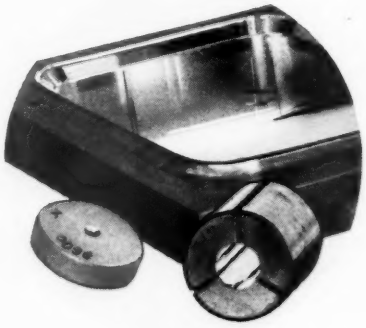

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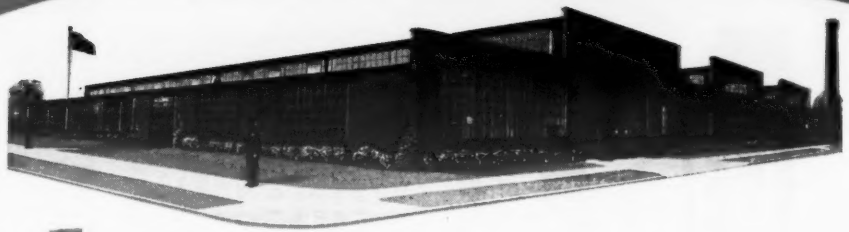

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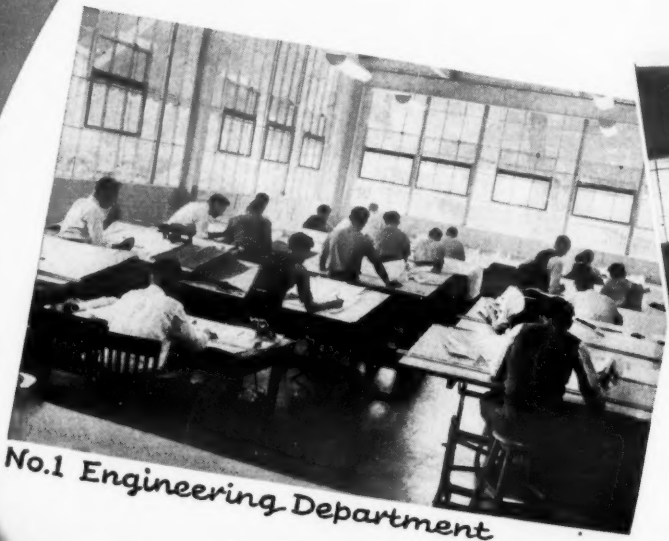

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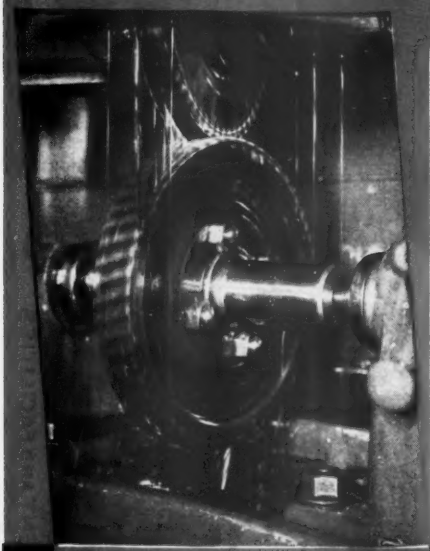

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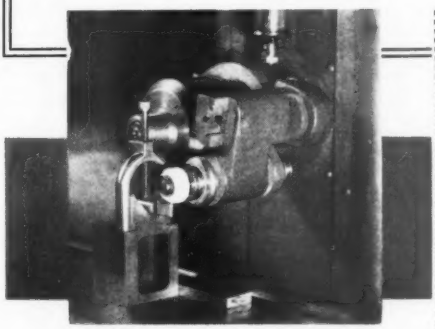

BLITZREV being used to grind radii on elongated piercing punch with dressed 1" diameter wheel at 10,000 r.p.m.

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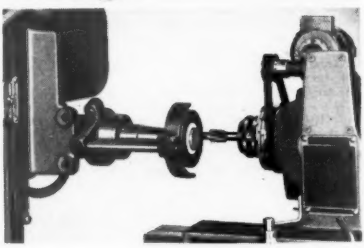

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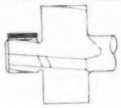
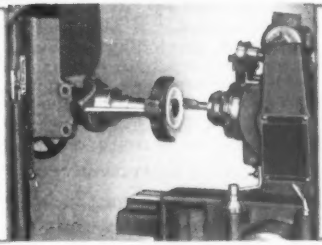
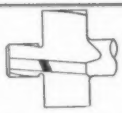
Gashing out the helical flutes of a special cutter being ground from the solid. The workhead is swiveled to the helix angle of the flute and the wheel is formed to give the desired flute shape. As the workhead slide is traversed, the helix is automatically generated by the spiral lead mechanism.



Cylindrical grinding the pilot diameter of a counterbore. Here the motor drive to the workhead is utilized.





Here the workhead spindle housing has been tilted vertically to grind the clearance angle of counterbore, using side of disc wheel.

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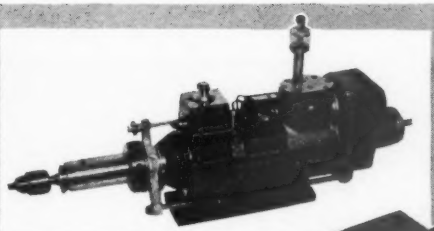

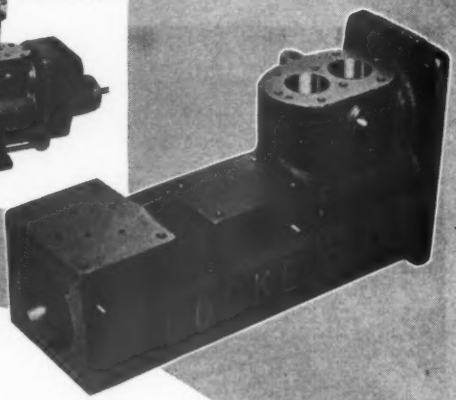

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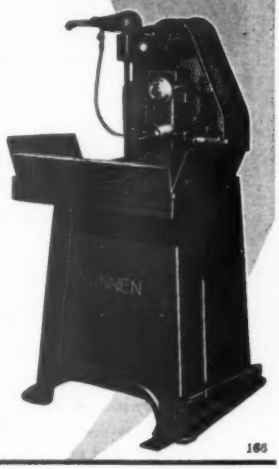
In addition to their tremendous saving in honing time, speed of assembly of parts was increased up to 300%; breakdowns were greatly reduced because parts now wear longer. So, finishing costs have naturally dropped to about 1/10th of the former cost (exclusive of material).

This part from a pneumatic drilling and tapping unit is made of cast iron—has one large blind hole 2⅛" in diameter and two open holes 1" in diameter. Tolerances are held to within .0005" and a 15 micro-inch finish is produced.

Here are other advantages you get from using this machine:

Handles wide range of sizes, from 125" to 2.625" • Produces accurate holes within .0001" • Can be set up, ready to operate in 1 minute Does not require skilled labor • Low in cost, economical to operate

Find out how these advantages can save time and money in your shop. Call in a Sunnen engineer, or write for complete details. If you have parts on which you would like recommendations, send them to the Sunnen Honing Laboratory.



SUNNEN PRODUCTS COMPANY

7947 Manchester Ave., St. Louis 17, Missouri

Canadian Factory: Chatham, Ontario

SUNNEN

166

Typical Jobs

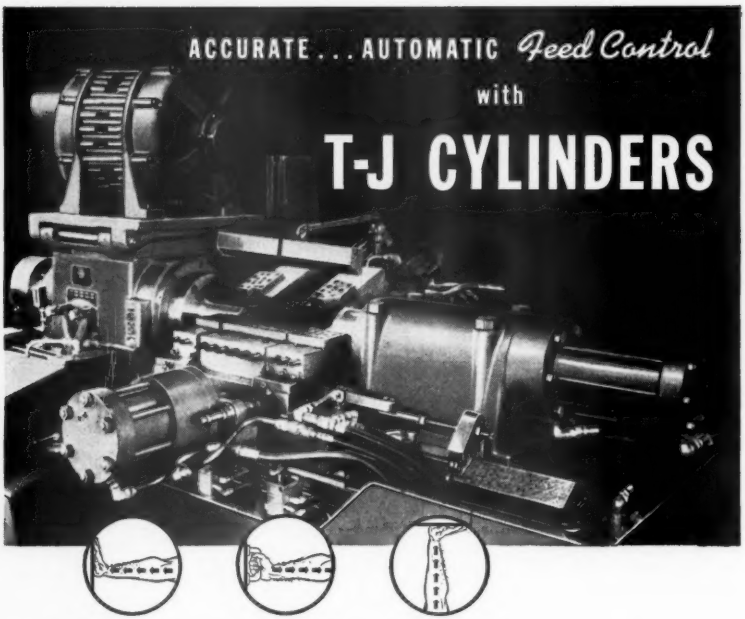
Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour.

Roller Bearing Outer Race. Finish improved from 12 micro inches to 2 micro inches.

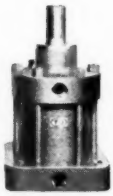
Compressor Yoke. Alignment maintained and better finish produced.

Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy.

Hydraulic Two-Way Control Valve. Hole is honed to eliminate leakage.



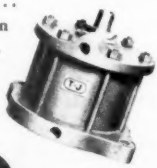
FOR POWER MOVEMENT IN ANY DIRECTION



T-J Cylinders on this Sparks Hydra-Feed Lathe furnish automatic and accurate control for feeding the work to cutters in this multiple tooling set-up.

Another tough job—and T-J Cylinders do it *right!*

More and more today in industries throughout the nation . . . T-J Air and Hydraulic Cylinders are used to simplify operations and save time and labor. For pushing . . . pulling . . . lifting . . . clamping . . . 100 lbs. or 50,000 lbs. Available in many standard sizes and styles . . . both cushioned and non-cushioned types. Backed by 29 years' experience . . . T-J engineered to do the job *better* and *cut costs!* Write for latest catalogs. The Tomkins-Johnson Co., Jackson, Mich.



TOMKINS-JOHNSON

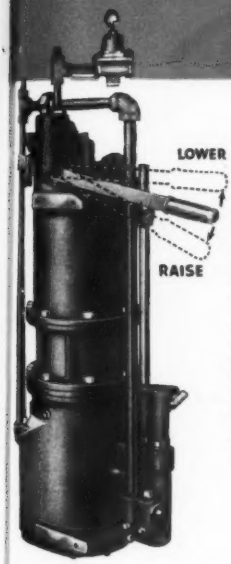
VALVES · AIR AND HYDRAULIC CYLINDERS · CUTTERS · CLINCHERS

T-J

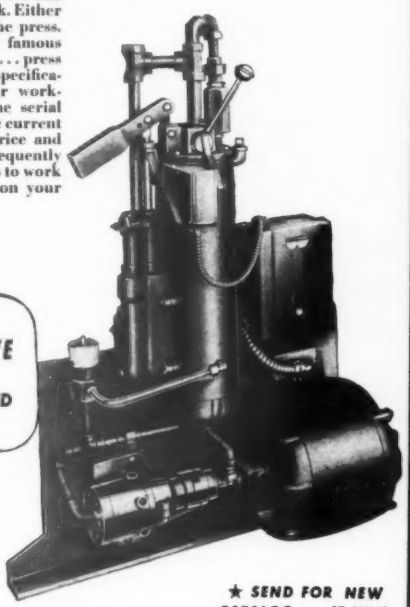
Now... Modernize

YOUR KRW ARBOR PRESSES

. . . FOR HIGH PRODUCTION WITH EITHER AIR-OIL OR MOTOR-DRIVEN POWER UNITS



● Thousands of standard KRW Hydraulic Arbor Presses can now be power equipped for production use by adding the new KRW Power Units. These units . . . either air-oil or motor-driven, . . . are available for 25, 50, 60 and 75-ton KRW standard presses. When power equipped, and utilizing simple, inexpensive dies, these standard presses are adaptable to a great many bending, forming, stamping and straightening operations . . . relieving heavier and more expensive equipment for other work. Either type power unit is easily attached to the press. Adding the unit in no wise affects the famous KRW two-speed hand pumping feature . . . press can still be hand-operated. Study the specification table shown here in terms of your work-pressure and motor needs. Give us the serial number of your KRW press and electric current requirements and we will quote you price and quick-delivery date. Put your idle or infrequently used KRW hand-operated Arbor Presses to work where they will pay big dividends . . . on your production line.



THIS IS THE NEW KRW AIR-OIL DRIVE THAT FITS STANDARD KRW HAND OPERATED PRESSES

THIS IS THE NEW KRW MOTOR-DRIVE THAT FITS KRW HAND OPERATED PRESSES

AVAILABLE TONNAGE PRESSURES
25-50-60 TON PRESSES

AIR PRESSURE	7" AIR CYLINDER		9" AIR CYLINDER	
100 TO 200 POUNDS	2" Oil Cylinder	1¾" Oil Cylinder	2" Oil Cylinder	1¾" Oil Cylinder
	10 to 22 Tons	14 to 29 Tons	17 to 35 Tons	23 to 47 Tons

75 TON PRESS

AIR PRESSURE	9" AIR CYLINDER	
100 TO 200 POUNDS	2" Oil Cylinder	1¾" Oil Cylinder
	25 to 51 Tons	33 to 68 Tons

KRW Motor Drive develops up to Full Capacity of any KRW Hand-Operated Press.

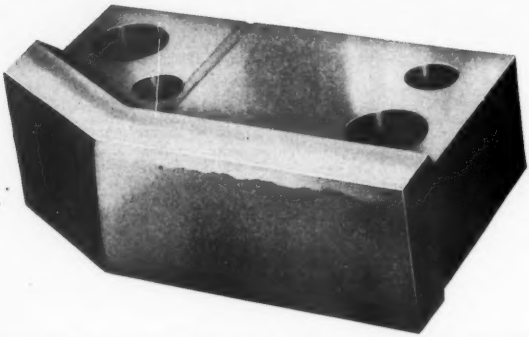
★ **SEND FOR NEW CATALOG . . . IT WILL SAVE YOU MONEY!**

K. R. WILSON, 215 Main St., Buffalo 3, N. Y.
Please send me complete information on 18
☐ KRW Air-Oil Power Units
☐ KRW Motor-Drive Power Units
Serial number of our KRW Press is.....
Voltage.....Cycle.....Phase.....
Firm.....
Address.....
City and Zone.....State.....

K. R. WILSON

215 MAIN ST., BUFFALO 3, N. Y.

Compositely fabricate dies ... by WELDING



(Above) Composite-Fabricated Die. The Base is Mild Steel, the Cutting Edges "Hard-As-Welded" Deposits of Eureka Oil Hardening Tool Steel Electrodes.

EUREKA TOOL AND DIE WELDING ELECTRODES, for composite die fabrication, facilitate planning and effect speedy results. Plain carbon, S. A. E. or low alloy NE steels are used as a base and weld deposits of the various Eureka Tool and Die Welding Electrodes constitute the cutting edges or working areas. Units so constructed efficiently replace those constructed entirely of tool steel.

ELIMINATION OF HEAT TREATMENT

Deposits of Eureka Electrodes, which are "hard-as-welded", eliminate the need of complete heat-treatment after welding.

COSTLY MAINTENANCE AVOIDED

The ability to produce a composite tool or die results in a working surface of any desired characteristic with a resilient core.

CONVERTING INTO COMPOSITE UNITS

Convert existing tool steel die sections into composite units to meet unusual conditions.

MACHINING IS FINAL OPERATION

In composite fabrication by welding, finish machining, drilling, etc., can be done as final operations.

INSERTS ELIMINATED

Composite fabrication by welding eliminates the use of inserts, which are often too costly, unsatisfactory or impractical.

MULTIPLE APPLICATIONS

In composite fabrication by welding, it is practical to weld two, three or four types of unlike materials on one die unit to perform individual functions.

Also facilitates repairs to die units

EUREKA TOOL STEEL ELECTRODES FOR FINE THE JOBS

Welding Equipment & Supply Co.

PIONEERS IN TOOL AND DIE WELDING ELECTRODES

223 LEIB STREET • FITZROY 3715 • DETROIT 7, MICHIGAN

can cause a drooping production curve

Select from Simonds Abrasive Company's line of Borolon* (aluminum oxide) and Electrolon* (silicon carbide) Grinding Wheels and you take the first step toward eliminating production-robbing fatigue. Fatigue in metal through improper grinding . . . fatigue of the grinding wheel from using the wrong abrasive combination . . . fatigue of the operator trying to force the wrong wheel to cut right . . . fatigue of the grinding machine through uneven wear and stress from out of balance wheels. Guard against this costly factor with efficient wheel selection.

Select the right wheels from all the shapes and sizes in the Simonds Abrasive line. Select the correct grain, grade, structure and bond from these precision manufactured, scientifically tested grinding wheels. Select with assurance of getting time-proven abrasive products for top grinding performance. Large stocks meet all your needs promptly, efficiently. In addition to the help of Simonds Abrasive Distributors, the Simonds Abrasive Data Book is a valuable guide to proper selection. Write for yours today.

** Time-honored Borolon and Electrolon Abrasive products are now distinguished by the name Simonds.*

SIMONDS ABRASIVE CO. *Is a Division of*

SIMONDS SAW AND STEEL CO.

Other affiliated companies

SIMONDS

SIMONDS

SIMONDS ABRASIVE CO.

SIMONDS ABRASIVE COMPANY • PHILADELPHIA 37, PA. • DISTRIBUTORS IN ALL PRINCIPAL CITIES

BAKER

BUILT-IN ADAPTABILITY

Permits DRILLING • BORING COUNTERBORING • FACING FORMING • TAPPING ON ONE NO. 150 HEAVY DUTY DRILL

Built of the best, built to last, built by Baker—that's the Model 150 Universal Quick Change Type Heavy Duty Drill.

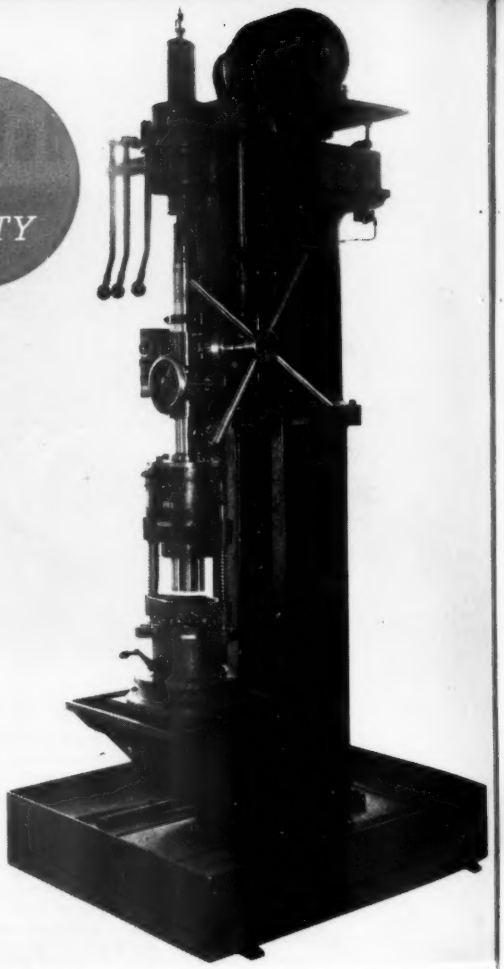
The "150" has ample capacity to drive 1½" h.s.s. drills to the limit of their efficiency in steel. Universal, quick-change type, the 150 Heavy Duty Drill is adaptable to boring, counterboring, facing, forming and tapping operations.

To gain greater flexibility, the vertical column assembly of the Model 150 is of 2-piece design; its lower frame, which bolts to the base, carries a standard plain table. Mounted on the lower frame is the entire upper unit assembly with speed and feed train drives for rotating and feeding the spindle.

The spindle itself is made of forged high-carbon steel, with spindle nose of No. 4 Morse Taper. Three conveniently mounted change-control levers provide for twelve quick changes of spindle speed. Speed changes are made by means of sliding hardened gears.

Equipped with automatic feed trip, the Model 150 provides a multiple depth stop accurately tripping the feed at different points, where quick changes of tools are made. Capstan handles are provided for rapid traversing of spindle and for hand feeding.

For detailed specifications write Baker Brothers today for literature describing their Model 150 Universal Quick Change Type Heavy Duty Drill, or if you prefer a Baker Brothers' representative will call to survey your needs.



Model 150 Universal Quick Change Type Heavy Duty Drill

FEATURES

1. Flange quill spindle construction for efficient adaptation of multiple head.
2. Easily, quickly retoolable for variety of single spindle or multiple drilling.
3. Twelve changes of speed.
4. Feed range from .005 to .143 per rev.
5. Furnished with five different feeds; transposing gives total of ten feed changes with one pair of gears.
6. Reversing controller for tapping.
7. All controls placed for easy, fast operation.

BAKER BROS.

INCORPORATED

TOLEDO 10, OHIO

Save Time

ON SHORT RUN MILLING OPERATIONS

by tooling your work on a

GORTON

with

Tracer Control

TRACER CONTROLLED MILLING IS ... SIMPLE ... FAST ... ACCURATE

This illustration shows just one of many applications of tracer control as applied to milling. Gorton tracer controlled equipment includes Duplicators, Pantographs and Electric Arc Etchers for milling, engraving, etching and many other metal removal operations.

Simplicity of operation, high spindle speeds and precision are built-in Gorton characteristics which enjoy enthusiastic approval among thousands of Gorton users throughout the world. It will pay you to investigate Gorton Tracer Control now.

GORTON PRE-DETERMINES RESULTS for YOU

Send us complete description with prints of one of your jobs. Our Engineering Department will send you a production estimate on the same job tooled on Gorton tracer controlled equipment—no obligation.

JOB FACTS

1. NAME OF PART—*Packaging Machine Cover*
2. MATERIAL—*Cast Iron*
3. MACHINE—*Gorton 9-J Duplicator*
4. OPERATION—*Mill Gasket Groove—10 in lot*
5. ACTUAL CUTTING TIME—*4½ Minutes each*
6. CUTTING TOOLS—*Gorton End Mill—10 Pieces per Sharpening*

WRITE TODAY FOR THIS BOOKLET

Bulletin No. 1455 will give you complete information on all Gorton tracer controlled machines . . . what they are . . . what they do . . . how they operate. It's yours for the asking

GEORGE GORTON MACHINE CO.

TRACER CONTROLLED MILLING

1211 RACINE STREET • RACINE, WISCONSIN

IT'S YOURS TO USE:

A temperature controlled laboratory, pictured above, is maintained in our plant to do your close work and tolerance checking. See the list of equipment at the right.

Ask us to send our representative to discuss your requirements of all kinds of form grinding, and tool, gage, or special machine building. We'll work to any tolerances down to tenths or even less when necessary. Prices are proportional to the degree of accuracy you require. Deliveries prompt.

Phone, wire or write us.

CONTROLLED TEMPERATURE LABORATORY EQUIPMENT

No. 5 Swiss Jig Borer.

36" P & W Measuring Machine (measures within 10 millionths).

Comparator for checking gage blocks to millionths.

Lapping machine for cylindrical and flat work to millionths.

Gaertner Toolmaker's Microscope J & L projector (62.5 to 1 for checking contour tolerances).

Miscellaneous comparators for measuring to various degrees of accuracy as required.

42 sets of Gage Blocks and other accessories.

BUILDERS OF PRECISION TOOLS — GAGES • • JIGS • • FIXTURES

TOOLS and GAGES

INCORPORATED

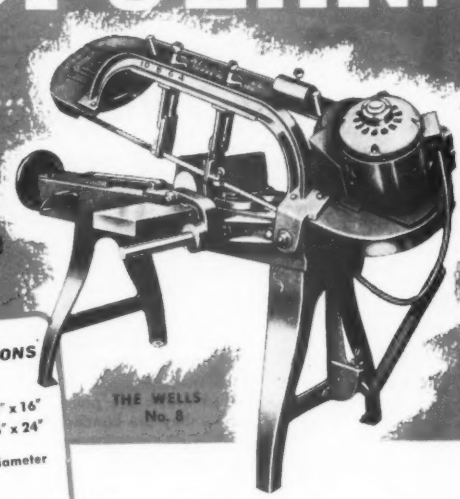
3112 EAST 63rd STREET • CLEVELAND 4, OHIO

MICHIGAN 7230

POPULAR!

because it's...

portable
practical
profitable



SPECIFICATIONS

CAPACITY:
Rectangular . . 8" x 16"
(Special Guides) 5" x 24"

ROUNDS: . 8" diameter

MOTOR:
½ H. P., A. C. or D. C.

SPEEDS: Selective 60, 90, 130 feet per minute

WEIGHT:
Approximately 665 lbs.

USERS like Wells Metal Cutting Band Saws for a number of very good reasons. In the first place these saws, though rugged in design and construction, are compact, self-contained, and readily portable. You can move them to a point most convenient to the work. They take up little floor space. Wells saws are also 100% practical—simple to operate, yet capable of handling a wide variety of work without special fixtures. A third important reason for widespread popularity, is that thousands of users have found them highly profitable. For a small investment, you get a versatile tool that can help you in many ways . . . in breaking bottlenecks . . . in getting work out in less time. See your local Wells distributor, or write for details.

Wells saws

Wells

Products by Wells are Practical

METAL CUTTING BAND SAWS

WELLS MANUFACTURING CORPORATION
1940 ASH STREET, THREE RIVERS, MICH.

32 Alundum Grinding Wheels are *Sharper!*

BY a patented Norton electric furnace process the grains of 32 ALUNDUM abrasive form as single, complete crystals — each one with a nubbly surface and many sharp points.

And no crushing to size is necessary — an operation which ordinarily results in many grains with flat sides. When crushed grains are bonded into a wheel it is often the flat side that is exposed in the surface instead of a useful cutting point. But not so with "32". The uncrushed grains are pointed on *all* sides — no matter how they are bonded into a wheel, one or more cutting points are exposed.

You can feel the difference yourself. Run your finger along the edge of a 32 ALUNDUM wheel and any other aluminum oxide wheel of similar specifications. You can see why "32" wheels cut faster and cooler. And because there are more cutting points doing the work, fewer dressings are necessary and wheel life is longer.

NORTON COMPANY, WORCESTER 6, MASS.

Distributors in All Principal Cities

W-1077A

Trade mark reg. U. S. Pat. Off.

Ask your Norton abrasive engineer to give you a Vectograph demonstration of 32 ALUNDUM abrasive.

TOOL GRINDING

"Fastest and coolest cutting wheel we ever had."

That is what the tool room man of a large plant said after trying a 32 ALUNDUM wheel. They had always found a certain 46 grit, K grade wheel best for cutters, reamers and end mills. But by changing to a 32A54-K5VBE they found that stock was removed faster with a much improved finish. The "32" wheel also held corner better and cut cooler, leaving the tools a nice, bright finish.

TOOL GRINDING

Six times around a 10" cutter without dressing.

A high speed steel 10" diameter milling cutter with 18 inserted teeth each ⅜" x 1⅝" was ground with a standard 46 grit, K grade wheel taking off .002" each pass for two revolutions. On the second revolution the last two or three teeth were burned a bright blue. On the third revolution, also taking off .002" all the teeth blued and the wheel showed a distinct glaze of steel.

With a 32 ALUNDUM wheel of the same grain and grade (32A46-K5VBE) .002" was removed from the teeth for each of six revolutions of the cutter. There was no burn and no wheel loading.

Almost Unbelievable

ARE MANY OF THE REPORTS THAT ARE COMING IN ABOUT *32* Alundum

INTERNAL GRINDING

Hole taper eliminated — wheel life tripled.

A maker of rayon pumps is grinding holes in a part made of high carbon, high chrome steel (SAE 51335 — Rockwell C56-57) removing .012" from each hole. They had tried many makes of wheels and the best life was an average of 10 holes per wheel. They changed to 32 ALUNDUM wheels (⅜ x ⅜ x ⅛"—32A80T-N8VBE) and life jumped to an average of 30 holes per wheel. They say, "The 32 ALUNDUM wheel breaks down only .002" per hole. Not only is this less than anything we have used before but the wheels remain true so that we can get a straight hole without any taper."

SURFACE GRINDING

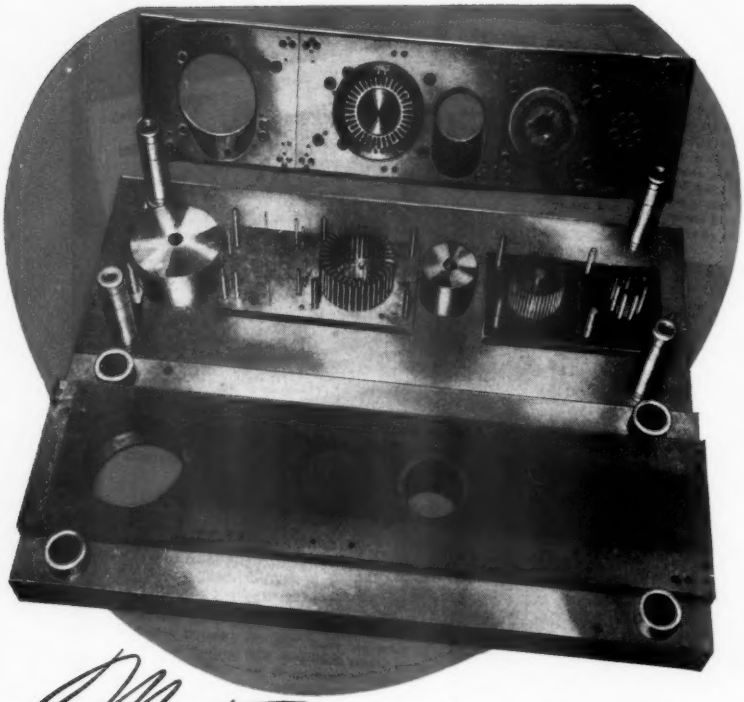
Difficult job done in half the time with better finish.

A machine tool maker was having a difficult time grinding flat a cast iron core plate (35% steel scrap) because the many grooves and holes in it caused a rapid dulling action of the wheel. Changing to a 32 ALUNDUM wheel (32A36-G12VBEP — 20 x 6 x 10") solved the problem. It easily removes .020 — .030" of stock between dressings compared to .010" for previous wheel. The "32" wheel can feed .002" per pass as against .001" and requires much less sparking-out time. Grinding time for both sides of the core plate went from 35 to 40 minutes down to 20 minutes. Finish was better than any obtainable before.

PORTABLE GRINDER

Wheel cost cut 60%

For grinding welds and steel castings with a portable grinder, a manufacturer changed to a 32 ALUNDUM cup wheel (32A161-R4B5). Wheel life was increased three times with good cut and finish. Wheel cost per day dropped from $3.38 to $1.29.



Masterpiece by CROMOVAN

100,000 pieces per grind . . . 100% increase in production over former dies . . . is the outstanding performance of this Cromovan six station, progressive lamination die. The die punches out both rotor and stator laminations complete . . . from .025 silicon lamination sheets . . . clearance tolerance of .0007 inch per side is strictly maintained between punches and die. All cutting surfaces of this die are made of CROMOVAN.

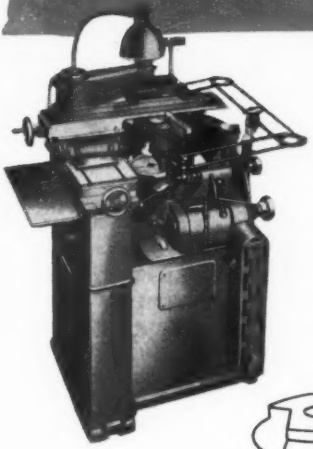
Call **Firth-Sterling**

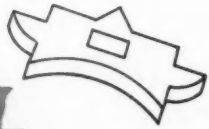
STEEL COMPANY McKEESPORT, PA.

NEW YORK • HARTFORD • PHILADELPHIA • PITTSBURGH • CLEVELAND • DAYTON • DETROIT • CHICAGO • LOS ANGELES

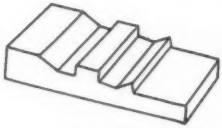
Fast

PROFILE GRINDING





WITHIN LIMITS OF ±0.0002"



THE STUDER PROFILE GRINDER

The Studer principle employs a tracer finger which follows the form of a template and transmits its movements to the grinding wheel through a pantograph. The wheel and stylus can be swiveled. Because the wheel is shaped beforehand proportionately to the exact shape of the tracer finger, an object can be ground over its entire length in one operation—with one wheel. Because a fixed template is used, errors due to incorrect manipulation are eliminated. A special template holder permits the grinding of circular forms or contours like cams over their entire circumference.

Now you can perform intricate profile grinding at practical high speeds and to exceptional degrees of accuracy! With the Studer Profile Grinding Machine Type PSM you can attain accuracy to within ±0.0002" in producing profile gages, straight or circular form tools, sectional dies, complete contours like cams, templates and similar parts of hardened steel. Profiles up to 5.9" in length can be ground from end to end in one continuous operation without moving work-piece or template. Circular work up to 4" in diameter can be ground, and flat pieces—several of which can be stacked for grinding at one time—can be handled up to 2" in thickness. Small sized profiles can be accurately produced without preliminary grinding to form, and clearance angles on parts such as form tools can be ground without removing the work from its original setting.

These are the highlight features of the Studer Profile Grinder. If you can use its exceptional accuracy, its speed and ease of operation, its amazing versatility, write for complete information.

We also represent in the United States these other makers of Swiss High Precision Equipment: Societe Genevoise d'Instruments de Physique (SIP), Andre Bechler, Mikron, Safag, Sallaz, Schaublein, Lienhard. Our engineers will be glad to work with you in specifying and using equipment for the highest precision machining.

HIGH PRECISION MACHINE TOOLS AND MEASURING INSTRUMENTS

COSA CORPORATION

COSA

CHRYSLER BUILDING
New York 17, New York

DREMEL

Improved MOTO-TOOL

Put the "POCKET SIZE MACHINE SHOP" to work

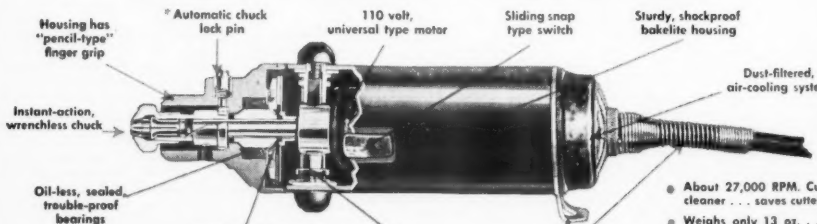
Moto-Tool Kit No. 2 has 23 professional accessories and Model 2 Moto-Tool in wood case. $28.50. (Items purchased separately would cost about $36.00; you save $6.50)
Moto-Tool No. 2 with one emery point $18.50

Dremel's improved, "pocket size machine shop" . . . the famous Moto-Tool . . . can save you hours, by speeding up work now being done by hand. It cuts, grinds, routs, carves, engraves, cleans and polishes. Invaluable as a sharpening tool alone . . . for taps, drills, gouges, chisels, tools and cutters (without tearing down "set-ups"). Moto-Tool is a "war veteran" . . . thousands of them were used at far-flung maintenance bases by every branch of the armed forces. For years such plants as General Electric, Westinghouse, Remington Arms, Ford, Nash-Kelvinator, Consolidated Aircraft, Northrup, Douglas, etc. . . . have bought Moto-Tools for use in tool rooms and on production lines.

Moto-Tool Stand (left) made of heavy cast iron, holds Moto-Tool at any position or angle..$4.50

Moto-Tool Shaping Table $2.50. (Shown with stand, right). Aids accuracy in routing and grinding.

LOOK FOR THESE MOTO-TOOL FEATURES


Housing has "pencil-type" finger grip
* Automatic chuck lock pin
110 volt, universal type motor
Sliding snap type switch
Sturdy, shockproof bakelite housing
Dust-filtered, air-cooling system
Instant-action, wrenchless chuck
Oil-less, sealed, trouble-proof bearings
Oversize armature shaft, hardened, ground and polished
Easily replaced commutator brushes
* Handy hanger hook, cord protector

- About 27,000 RPM. Cuts cleaner . . . saves cutters.
- Weighs only 13 oz. . . . shaped to fit the hand.
- Dynamically balanced for vibrationless operation.

*Patented

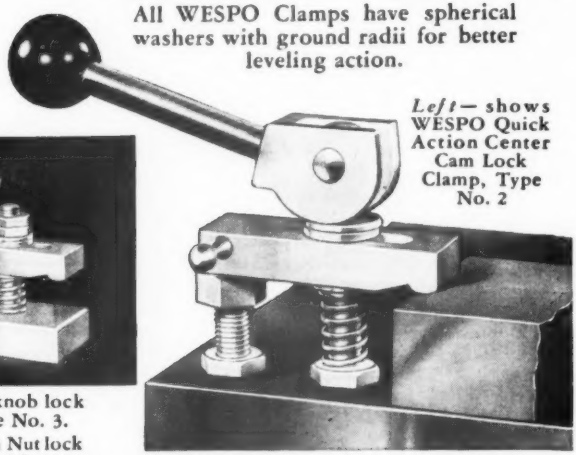
SEE YOUR MILL SUPPLY DEALER
IF HE DOES NOT HANDLE MOTO-TOOL, WRITE THE FACTORY

DREMEL MFG. CO. - Dept. 526-L - RACINE, WISCONSIN

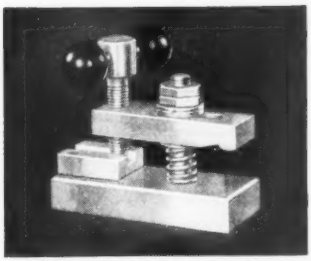
SAVE on FIXTURE DESIGNING WITH BETTER WORK HOLDING

WESPO *Improved* FIXTURE CLAMPS

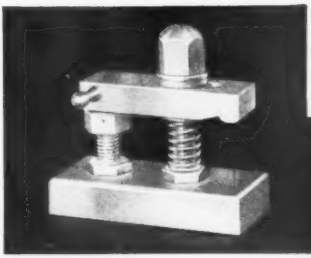
All WESPO Clamps have spherical washers with ground radii for better leveling action.



Left— shows WESPO Quick Action Center Cam Lock Clamp, Type No. 2



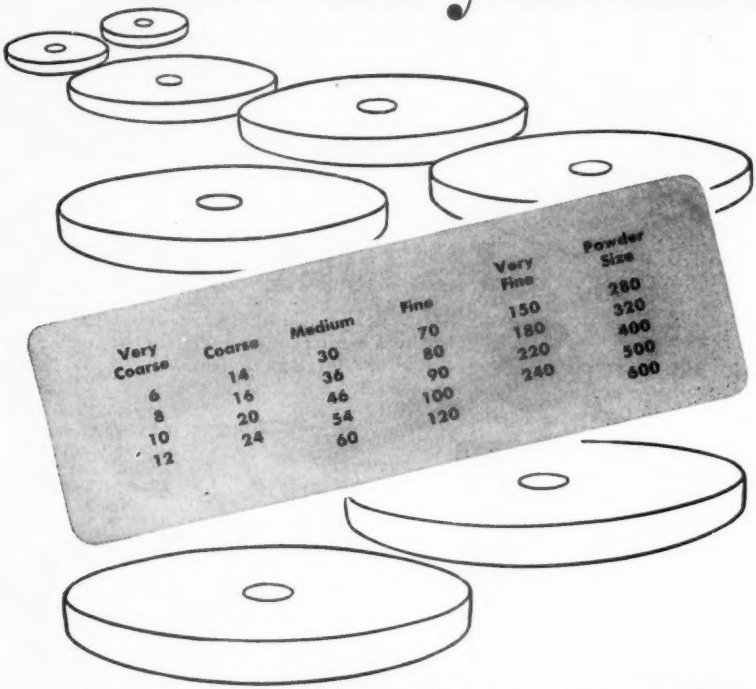
Above— End knob lock clamp. Type No. 3.
Below—Acorn Nut lock Type No. 5



WESPO Clamps can be included in your fixture layouts. They are precision made of heat treated alloy steel, cadmium plated, made in 5 types of 6 sizes each. Send for exact scale template sheets and latest bulletin.

WEST POINT MFG. CO.
19631 Merriman Court
FARMINGTON, MICH.

How do you tell



A good rule for good grinding... **CALL**

which grit to use?

Listed is a commercial classification of standard abrasive grit sizes. They come in a wide range... from 6 classified as very coarse to 600 classified as powder size. And, the variety is further extended by special sizes and combinations. Yet, each one is designed to do a specific job better than any of the rest.

To complicate correct choice even more, there is a long list of variable factors to consider. Among these, you'll find wheel speed, machine condition, specified tolerances, material analysis, related production schedules, and a host of others.

The correct selection hinges on the review which is given to all the controlling factors. Yet...grinding efficiency and economy depend on the right answer.

That's why The Carborundum Company has put together a practical program... a service now deemed essential by many concerns who have been successful in getting improved grinding in terms of better finishes, or at lower cost.

Your nearest contact to this service is a CARBORUNDUM representative You'll find him willing and helpful. Through a sound knowledge of abrasives and first-hand experience of their use and application in the many plants he contacts, he is able to make intelligent recommendations and suggestions. On the more uncommon problems, he can even call on our Abrasive Engineers who are more fully qualified to tackle the tough problems. And, sometimes, the answer comes from the modern laboratories at CARBORUNDUM—where scientists and technicians probe for new information on abrasives, practices and developments.

Here is a sound approach—not only to getting the right grit—but the right combination of grit, bond, grade, structure and all the other parts that make up a grinding wheel. *Plus* knowledge and experience invaluable in modern grinding methods and procedures. It's easy to use. It incurs no obligation. It makes sense. The Carborundum Company, Niagara Falls, New York.

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BONDED ABRASIVES

WHEELS
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HEAT TREAT SMALL PARTS

In Your Own Plant

SAVE TIME AND MONEY

With these Versatile Cooley Furnaces

- One model to operate to 2000° F.
- One model, 2 sizes, to heat to 1850° F.
- Use for both hardening and tempering.
- Simple and economical to operate.
- Positive control over high and low heats.
- Uniform temperatures assure results.

Power Cost Less Than 4 Cents per Hour

To hold 1600° F. in the MH-3 furnace requires less than 2 kw. At power rate of 2c per kw.-hr., operating cost is under 4c per hour. Cooley furnaces are easily installed —ready for immediate service by connection power lines to two terminals. Replaceable heating elements are embedded in refractory materials, protecting against atmospheric attack. Quiet in operation—no fumes or odors—no ventilating necessary—they can be located at any convenient place in the shop.

ESSENTIAL FOR TOOL AND DIE SHOPS

More Profitable Reasons for Using Cooley Furnaces

1. Hardening, drawing and tempering small batches.
2. Small parts can be normalized and annealed quickly and easily.
3. Convenient for high speed pre-heating.
4. Expedites emergency repairs.
5. Use as a pilot furnace to pre-determine production heat-treating technique.
6. Harden and draw in the same furnace with assured temperature control at either heat.

TWO NEW OPTIONAL FEATURES AVAILABLE

1. Counter Weighted Vertical Lift Door conserves heat where door need not be fully opened. Replaces hinged hearth door at $20.00 additional on MH-3, MH-4—standard on MH-5.

2. Heavy Gauge Steel Stand—For ease of installation and operation—locates furnace at most convenient operating height and provides additional working and storage space. Add $35.00 to regular price.

THREE SIZES—MH-3, MH-4—1850° F. MH-5—2000° F.

Type	Chamber Capacity	Amps 115 V	Watts	Amps 230 V	Price
MH-3	8"W 6"H 14"L	29.6	3400	14.8	$146.00*
MH-4	10"W 6"H 18"L	.....	4500	19.6	$222.50*
MH-5	8"W 6"H 14"L	.....	4800	20.9	$340.00*

*All furnaces complete with Hearth Plate.

Automatic Control—Indicating Controlling Pyrometer—Thermo-couple and lead wire—approximately $150.00

FREE!

HEAT TREATING HELP

Our experience in heat-treating is available to you. State your problem . . . write for Bulletin No. 56 today—no obligation. No salesman will call.

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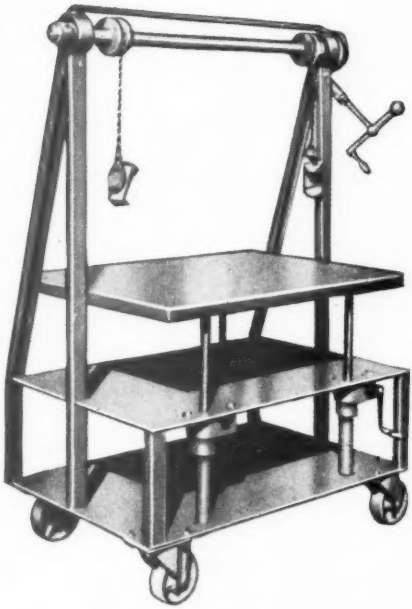
ONE MAN HANDLES DIES UP TO *3000 LBS!*



With the new BARRETT MULTI-DUTY DIE TABLE, one man does everything! Here's a lifting table, work bench, die separator, and floor truck—all in one—designed to save time and energy; cut costs in storing, moving and setting up dies. Note these outstanding advantages:

1. Makes die separation and assembly a simple, one-man job.
2. Handy crank-operated hoist does the heavy lifting.
3. Table is adjustable to height from 24″ to 40″ above floor.
4. All gears are accurately machined and fully enclosed.
5. Husky all-steel construction; electric welded, rigid.
6. Easy to operate; no complicated parts to give trouble.
7. Rolls easily on heavy-duty ball bearing casters.

Offered in two sizes with 44″ x 28″ and 36″ x 24″ tables; safe load capacities from 2,000 to 3,000 pounds. Write today for descriptive bulletins.

BARRETT-CRAVENS CO., 3269 W. 30th St., Chicago
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One Man Does More Than 3 or 4 . . . With A Barrett

Barrett Handling Equipment

HAVE YOU TRIED MO-MAX COBALT?

HIGH SPEED STEELS

Whenever your cutting tools are operating under such severe conditions that a cobalt high speed steel is desirable, specify MO-MAX COBALT. It is available in four distinctive types, two with 5.00% cobalt and two with 8.00% cobalt.

If your regular sources cannot make prompt delivery on MO-MAX COBALT, we shall be glad to direct you to an available source of supply. In writing, please describe the proposed application.

Full information will be found in the MO-MAX Handbook. See Pages 27-28.

Buyer's Guide to Brands of MO-MAX

"LMW"	Allegheny Ludlum Steel Corp.
"MOHICAN"	Atlas Steels Limited
"BETHLEHEM HM"	Bethlehem Steel Co.
"MO-CUT"	Broaburn Alloy Steel Corp.
"STAR MAX"	Carpenter Steel Company
"MOLITE M-I"	Columbia Tool Steel Co.
"REX T-MO"	Crucible Steel Co. of America
"DI-MOL"	Henry Disston & Sons, Inc.
"HI-MO"	Firth-Sterling Steel Company
"REX T-MO"	Halcomb Steel Company
"MOGUL"	Jessop Steel Company
"TATMO"	Latrobe Electric Steel Co.
"MIDMAX"	The Midvale Co.
	St. Lawrence Alloys, Inc.
"S. T. M."	Simonds Saw & Steel Co.
"MO-TUNG"	Universal-Cyclops Steel Corp.
"8-N-2"	Vanadium-Alloys Steel Co.
"VUL-MO"	Vulcan Crucible Steel Co.

ONLY MO-MAX GIVES YOU all THESE ADVANTAGES

1. MO-MAX has superior cutting qualities. It is a happy combination of great toughness with high hardness.
2. The machinability of MO-MAX is unexcelled, particularly in grinding.
3. MO-MAX is economical. Its specific gravity is about 8% less than that of 18% tungsten steel. Thus for the same weight of high speed steel, 13 bars of MO-MAX are obtained as compared with 12 similar bars of an 18% tungsten steel.
4. In addition to the standard general-purpose composition of MO-MAX high speed steel, several special types have been developed for particular purposes. There are four with a high cobalt content, one high in vanadium and two that are especially suitable for hot die work.
5. MO-MAX was the first of the modern molybdenum high speed steels. For 13 years MO-MAX has demonstrated its superiority in cutting tools.

★ ★ ★

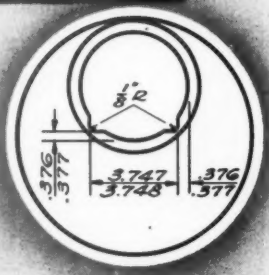
Send for your copy of the MO-MAX Handbook, sixth edition. Get the full story about this remarkable steel, including easy-to-follow instructions on heat treating.

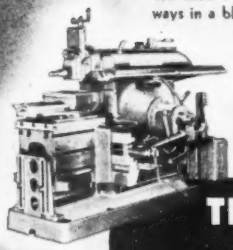
INTERNAL SHAPING...

In the field of internal shaping alone, Cincinnati Shapers are used on a long list of "hard to get at jobs"—from cutting internal key ways to cutting symmetrical and non-symmetrical holes.

We show a Cincinnati Shaper shaping internal key ways in a blind hole—a "hard to get at job." Remember, a Cincinnati Shaper, the tool of many uses, will always be busy in your shop.

Write for Catalog N-2, describing these powerful accurate Shapers.





THE CINCINNATI SHAPER CO.

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Announcement of Special Interest to Plant Engineers

Bunell Engineering, Designing, and Building Service for the Tools, Dies and Special Machines of Industry

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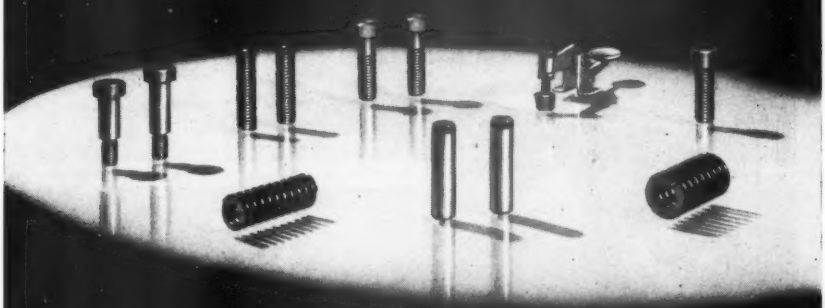

These assembly items are known throughout industry for their quality and precision.
For quick service draw on our large stock of Dowel Pins (163 Standard sizes plus oversizes), Springs, Socket Head Cap Screws, Stripper Bolts, Set Screws and Toggle Clamps.
Standard and Special Die Sets in all sizes.

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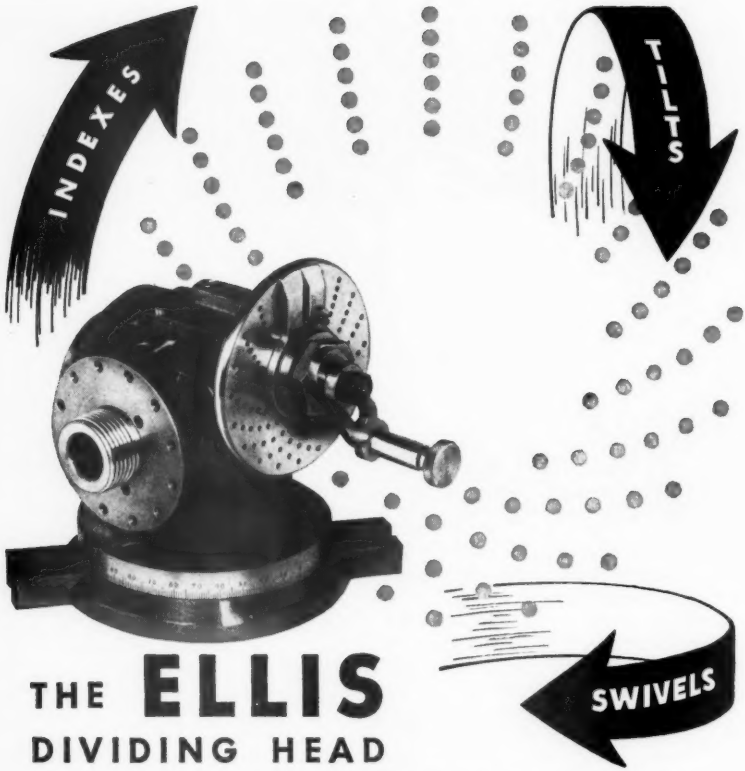
DETROIT DIE SET CORPORATION

2895 W. GRAND BLVD. • DETROIT 2, MICH.

DETROIT DIE SETS ★



THE ELLIS DIVIDING HEAD

Many unique features make the ELLIS Dividing Head more than an ordinary indexing fixture. It is a precise, rugged unit with 6-1/2" normal swing increased to 11" swing through the use of riser blocks. It TILTS more than 100 degrees in the vertical plane—SWIVELS 360 degrees in the horizontal plane—INDEXES by crank, or directly by hand. Work is held between centers, or in chucks or collets. The ELLIS Dividing Head is a *universal* work head that will increase the production versatility of your milling machines, grinders, drill presses and jig borers—write for complete details today.

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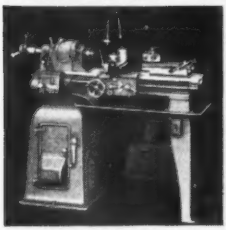
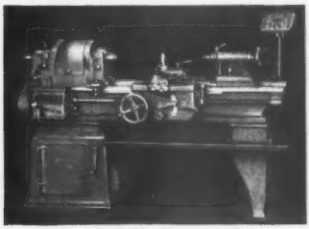
SOUTH BEND *Precision* LATHES

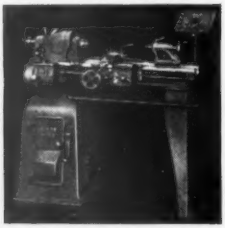
ENGINE LATHES · TOOLROOM LATHES · TURRET LATHES · ATTACHMENTS



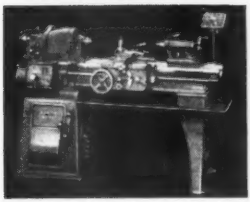
No. 1001-Z SOUTH BEND TURRET LATHE



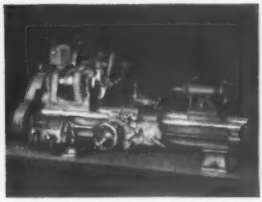
16" x 6' SOUTH BEND TOOLROOM LATHE



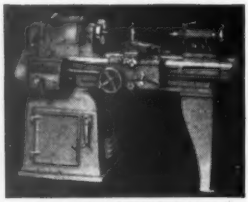
10" x 3½' SOUTH BEND TOOLROOM LATHE



13" x 5' SOUTH BEND TOOLROOM LATHE



9" x 3' SOUTH BEND MODEL A BENCH LATHE



14½" x 5' SOUTH BEND ENGINE LATHE

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Illustrates in full color, and gives complete, detailed specifications of all types, sizes, and models of South Bend Precision Lathes; shows all South Bend lathe attachments and accessories. Mailed free on request.

A Size and Type for Every Need

Accurate, versatile, fast, and easy to operate, South Bend Precision Lathes simplify the handling of difficult, close tolerance jobs in all types of laboratory, toolroom, production, and maintenance work. Practical South Bend attachments and accessories increase the scope of these lathes, and speed tooling and production.

South Bend Engine Lathes and Toolroom Lathes are made with 9", 10", 13", 14½", and 16" swings, and bed lengths to 12'. Turret Lathes are made with 9" and 10" swings, and maximum collet capacities to 1".

SOUTH BEND LATHE WORKS

432 E. MADISON ST. • *Lathe Builders Since 1906* • SOUTH BEND 22, IND.

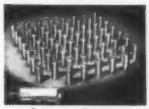
Electric Grinding Attachment

Draw-in Collet Attachment

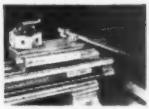
Draw-in Collet Attachment

Center and Follower Rests

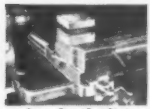
Telescopic Taper Attachment



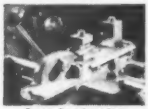
Collets and Collet Sets



Handlever Bed Turret



Square Turret Tool Block



Double Tool Cross Slide

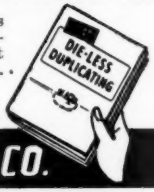
Double Tool Cross Slide

With Two DI-ACRO BENDERS

A difficult production problem of forming two bends in a long length of tubing was solved by "teaming up" two DI-ACRO Benders as illustrated. This dual-forming arrangement saved installation of special machinery. Two accurately formed bends are obtained in one operation—without distortion of the tube and at a cost competitive to power operated equipment. More than 300 pieces are completed per hour—600 individual bends.

"DIE-LESS DUPLICATING" Often Does it Quicker WITHOUT DIES

This is but one example of how DI-ACRO precision machines —Benders, Brakes and Shears—can accurately and economically duplicate a great variety of parts, pieces and shapes, without die expense. Write for catalog—"DIE-LESS DUPLICATING"..



◀DI-ACRO is pronounced "DIE-ACK-RO".

DI-ACRO PRECISION MACHINES DIE-LESS DUPLICATING

O'NEIL-IRWIN MFG. CO.

315 EIGHTH AVENUE • LAKE CITY, MINNESOTA

USE SCULLY-JONES

Style "B"

DRILL CHUCKS

See page 44, Scully-Jones Catalog No. 500 for Style "B" Drill Chucks.

. . . and save the difference between the cost of straight and taper-shank drills.

It's as much as 25% on drills ½ inch and under.

Scully-Jones Style "B" Drill Chucks are tough—take a lot of punishment and outlast many drills.

Stock Delivery

Write for complete information on prices and sizes—today.

Refer to the Scully-Jones Catalog showing over 500 types and sizes of cutting tools, collet chucks, boring equipment, centers, etc.

Scully-Jones AND COMPANY

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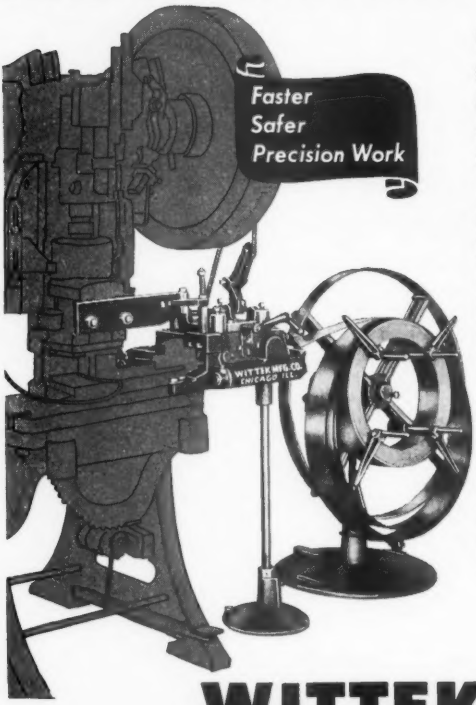
Planning Peacetime Production Using Coiled Strip Stock?

Equip with
WITTEK
Automatic Roll Feeds and Reel Stands



Wittek Roll Feeds are being used extensively by war plants in their large volume production of high quality metal stampings. The flexibility of Wittek Roll Feeds will assist these plants in their peacetime conversion through their adaptability to various jobs. Keen competition will demand the utilization of equipment to its point of highest efficiency. If your postwar plans include punch press production of parts from coiled strip stock—investigate now the many possibilities of Wittek Roll Feeds and Reel Stands.

Write for catalog, prices and recommendations

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Automatic
ROLL FEEDS
AND
REEL STANDS
WMCo

Work Simplification...

MULTIPRESS has key part in work-simplification at LIONEL Corporation

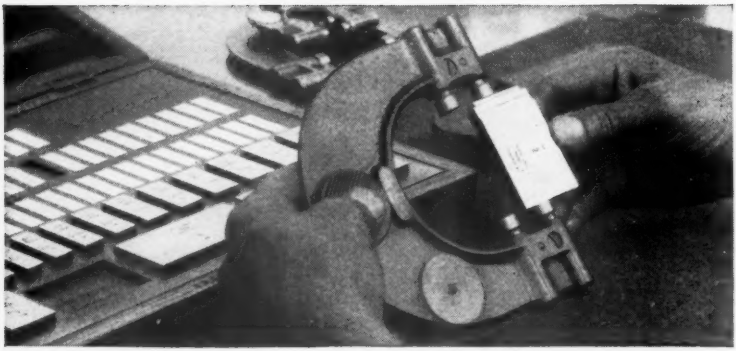
● Here's a close-up of a MULTIPRESS, equipped with a HydrOILic Index Table, doing its part in a work-simplification program that lowered costs and *doubled* production at the Lionel Corporation.

The MULTIPRESS rivets coupler coils to the "trucks" of the famous Lionel toy trains. Trucks are fed to each MULTIPRESS operator on "train-track" chutes. Working with both hands, the operator simply fits a coupler coil from a nearby bin to each truck, loads the assemblies onto the index stations—and MULTIPRESS does the riveting at the rate of a thousand per hour!

Note how the streamlined compactness of this powerful little bench-size tool lets it fit close to the conveyor belt, permits parts-supplying chutes of minimum length, and affords maximum room for conveyor equipment.

MULTIPRESS offers quiet, oil-smooth accuracy of power in 4, 6, and 8-ton capacities, with manual and automatic controls for any type of ram action needed. The HydrOILic Index Table is only one of many standard attachments and tooling accessories that adapt the basic MULTIPRESS to widely varying needs. Write for details! The Denison Engineering Co., 1197 Dublin Rd., Columbus 16, Ohio.

DENISON
EQUIPMENT for APPLIED
HydrOILics



Tolerances Worth Maintaining Are Worth Jo-Block Protection

When you set up dimensional inspection tolerances, it's to insure a specified class of fit in assembly, or to make sure of parts-interchangeability, or for some other good reason. The harder it is for an inspector to be *sure* he's staying within limits, *the more it costs.*

So, why not put a set of Ford Jo-Blocks on guard? Make it part of somebody's routine to check every working gage—whether snap-gage, micrometer caliper, dial indicator, plug-gage, ring-gage, or any other dimensional test device—with genuine Ford Jo-Blocks at definite, frequent intervals. Then, you'll *know* that everybody concerned is "speaking the same language" of measurement. Chances are that inspection will speed up and rejections will be fewer.

Jo-Blocks are not expensive. They're made to three warranted accuracy standards—plus or minus .000002″, .000004″ and .000008″. Sold throughout the Americas as single blocks or in sets (metric measurement, too). Many accessories available to expand and facilitate use of Jo-Blocks.

FREE—NEW CATALOG

Write for catalog No. 17, containing illustrated applications of dozens of Jo-Block uses. Address: Ford Motor Company, Johansson Division, Dept. 515, Dearborn, Michigan.

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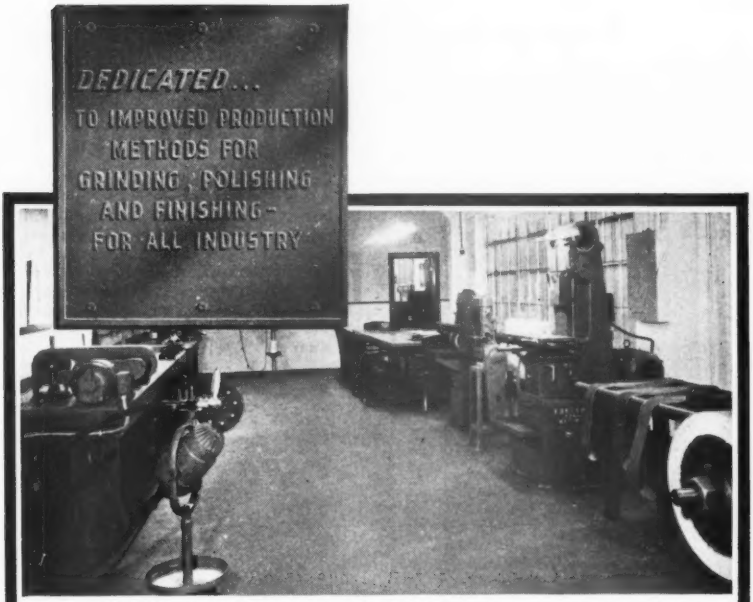

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HOLD AND TURN WORK 360°..... AT ANY ANGLE

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Universal Positioner

Holds all types of benchwork firmly in ANY position, at ANY angle and permits the workman to do a faster, better job by enabling him to work freely with BOTH hands. Change position and angle of work on horizontal, vertical or axial planes quickly and easily as desired, and lock it in position.

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Hold and position the job in one hand . . .
Hold tools and work with the other hand . . .

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- Tiring position
- One arm does most of work
- Other arm occupied holding
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- Danger of injury
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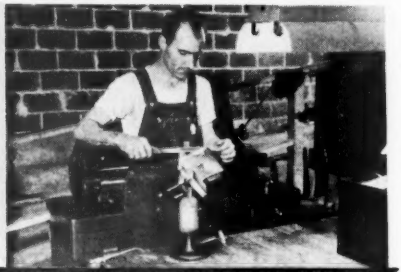

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Position the work on any plane, at any angle, on Powrarm Positioner . . .
Powrarm Positioner holds it while you work with both hands . . .
Change position and angle of work instantly . . .

100% PRODUCTIVE

- Standing in natural position
- Both hands working
- Powrarm Positioner does all holding
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Wherever work must be held securely and turned to various positions

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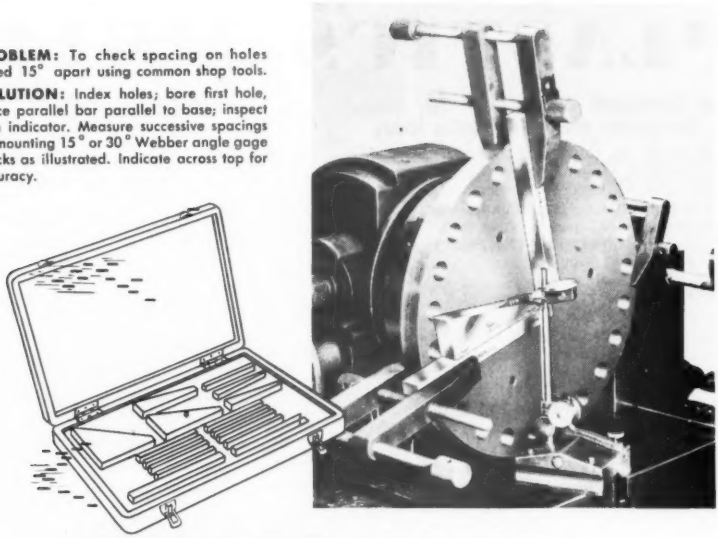
SOLUTION: Index holes; bore first hole, place parallel bar parallel to base; inspect with indicator. Measure successive spacings by mounting 15° or 30° Webber angle gage blocks as illustrated. Indicate across top for accuracy.



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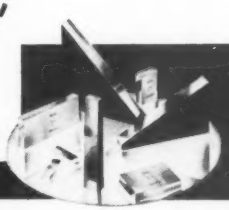

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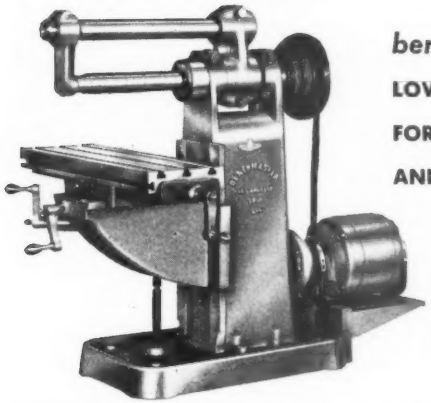
ONE for TWO jobs



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A—Quick Change Bit Tightening Device.
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Handles any and all lathe operations. Also for planer, shaper and special equipment.

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- Does the work of 10 different toolholders—at a fraction of the cost.
- Locking Device has greater rigidity and positive locking. Can be locked in either right or left hand position.
- New Cam Design provides for increased rigidity of the tool bit. Retaining rings provide for easy removal of Cam for cleaning, oiling or replacement.
- Bit and Holder are always parallel.
- Quick change bit tightening device. (See "A".)
- 100% interchangeability of parts.
- High quality ground square Bit and Square Box Wrench furnished with each tool.

SIZES

Holder No.	Holder Size	Bit Size
00	3/8 x 3/4 x 5 1/2	1/4 x 2 1/2
0	3/8 x 3/4 x 5 1/2	5/16 x 2 1/2
1	1/2 x 1 1/8 x 6 1/4	3/8 x 3
2	5/8 x 1 5/8 x 7	7/16 x 3 1/2

EXTRA LONG BITS and ROUND BORING BARS AND THREADING TOOLS are available for use in the same toolholder.

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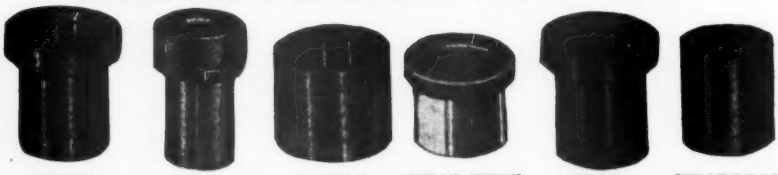

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These Drill Jig Bushings are made of high grade tool steel—Rockwell C 62 to 64 hardness.

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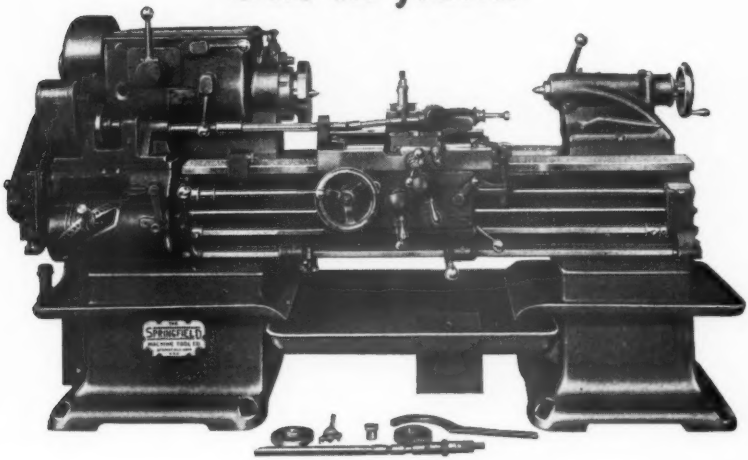

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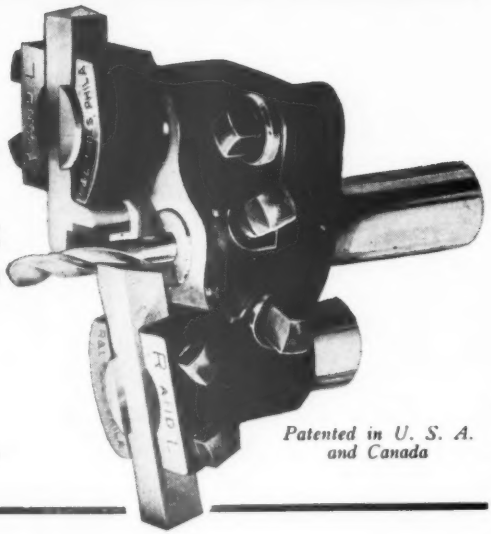
When The Tool Is an R and L Combination Turning Tool



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One R and L Combination Turning Tool, the only combination right hand and left hand tool on the market, actually does the work of 14 tools.

You can use an R and L for all these right hand or left hand applications:

- **Roller Box Tool**
- **Centering and Facing Tool**
- **Knee Tool**
- **Pointing Tool**
- **Back Rest**
- **Floating Drill Holder**
- **Balanced Turning Tool**

The change from right to left or vice versa takes only ten seconds.

√ *CHECK THESE OUTSTANDING FEATURES*

- **Made of extra tough, heat treated alloy steel; unconditionally guaranteed not to bend or give way.**
- **Essential parts ground to extreme accuracy affording perfect alignment at any point of adjustment.**
- **Back Rests, or burnishers, have almost diamond hard surfaces eliminating metal pick-up and marring of work surface.**
- **Interchangeable Roller Back Rests furnished if desired.**
- **Precise adjustment on both cutting tool and pressure of burnishers.**
- **Tool bits wear longer because they are ground only on top side, or end.**
- **Less cross-slide clearance required; saves time and often permits working with cross-slide tools while turning or drilling.**
- **On turnings, the R and L Combination Tool produces highly polished surfaces, true to size, and straight.**
- **Usable either for roughing or finishing; extra heavy cuts possible because thrust is always in direct line with Back Rest.**
- **Longitudinal adjustment permits turning of two diameters to any length within tool capacity.**

All these and many other features are shown by photographs and drawings in descriptive booklet mailed without cost or obligation. The booklet illustrates the tool set-up for various operations, and indicates speed and simplicity of its adaptation to various jobs. Prices and full specifications of many available sizes are included. Write for your copy today.

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- **Saves Production Time**
  In handling dies and heavy fixtures; stacking barrels, boxes, etc.; loading and unloading trucks

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Entire frame of machine of structural steel, electrically arc welded throughout
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Two swivel casters and two stationary wheels with push bar furnished
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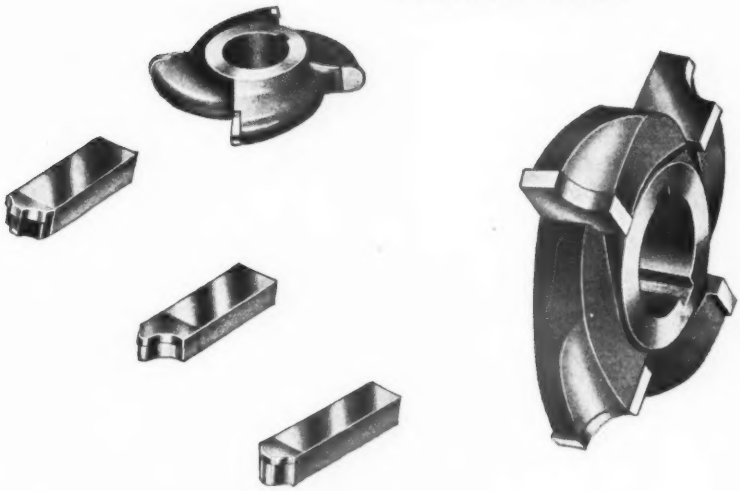

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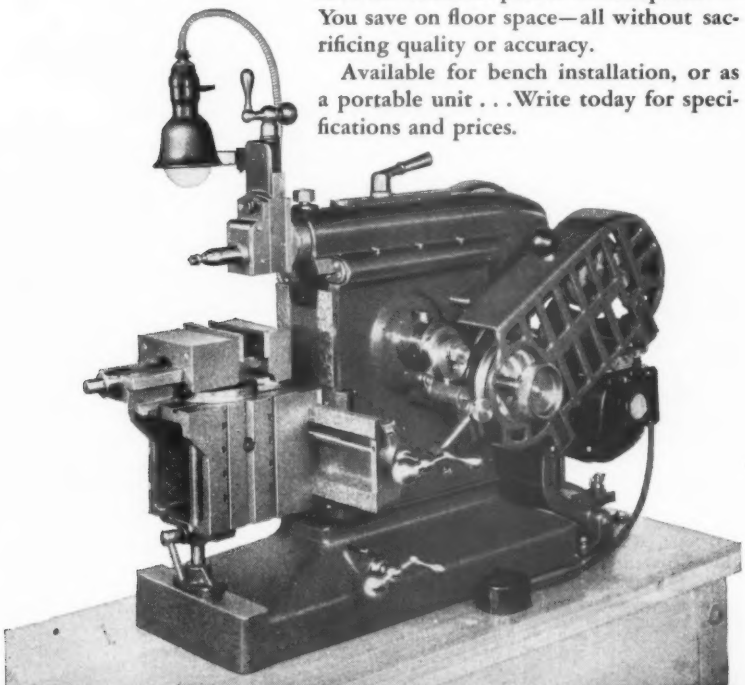
Available for bench installation, or as a portable unit . . . Write today for specifications and prices.



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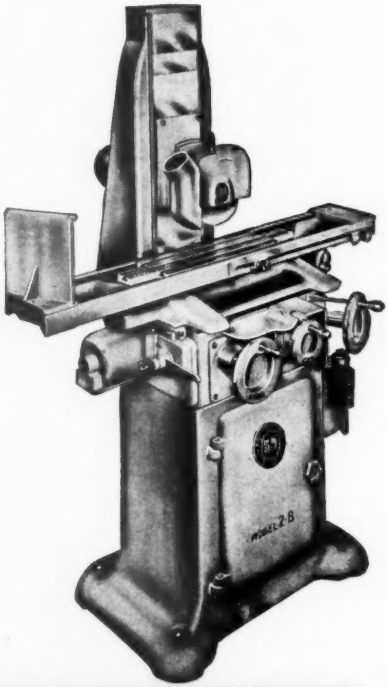

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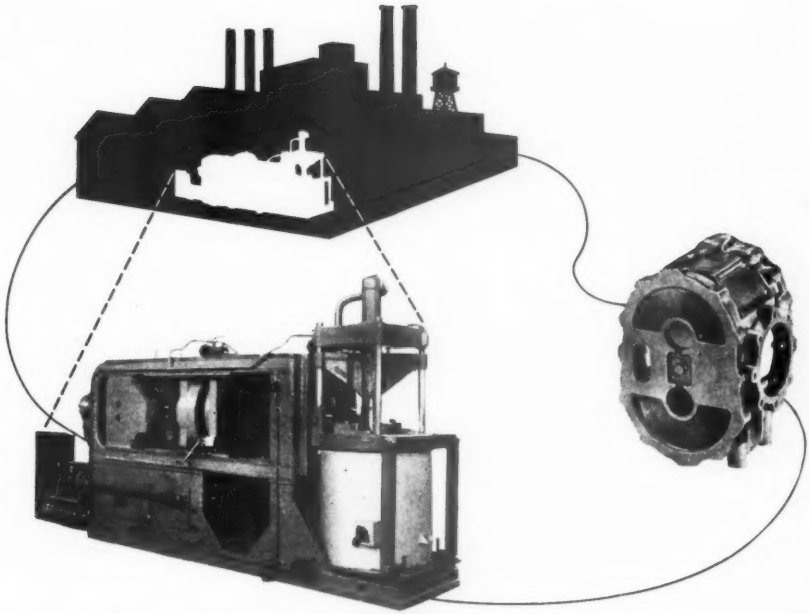

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6

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Latrobe's exclusive process of *desegatizing* makes all these steels *free from the usual carbide segregations.*

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on hardened DIES, PUNCHES, PARTS, with

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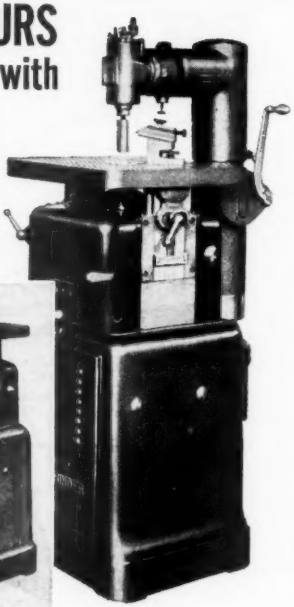

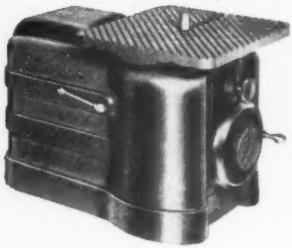

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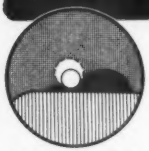

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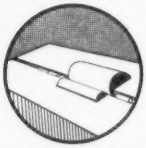

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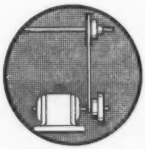

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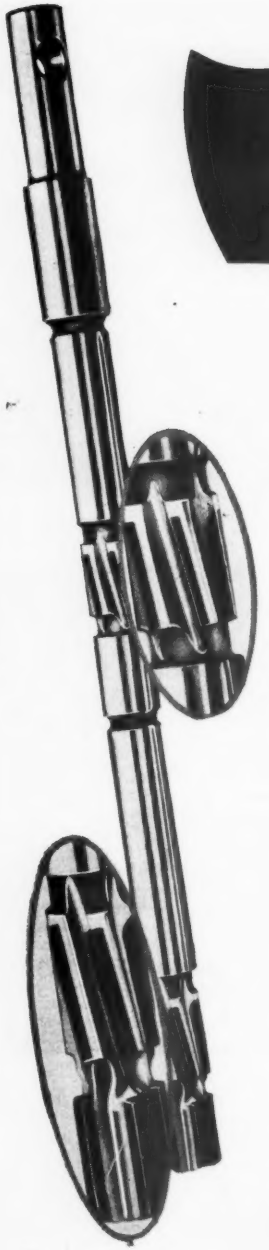

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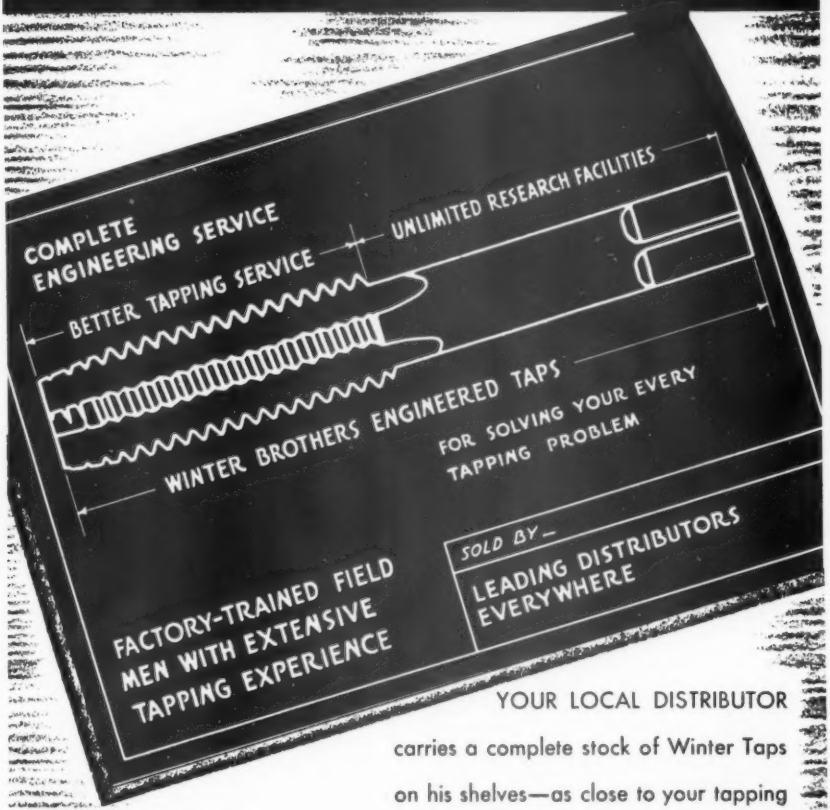

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The question of worker efficiency that is being raised with increasing frequency and in widening circles is the subject of a Washington conference, sponsored jointly by the Bureau of Labor Statistics and the Department of the Budget's Division of Standards, and participated in by management, labor and government. An attempt is being made to define productivity or production per man-hour in terms that can be used as standards of measurement for worker output.

As long as it can be said that 21% of U. S. homes have no electricity; that 31% have no running water; that 43% have no private bath and that 27% have no refrigeration, there is no danger of our running out of things to want, things to make and things to buy and sell. The answer is to produce more and more.

That is the answer that has proved out over the many years during which this country's industrial output of goods per man-hour has increased at a rate of 50% every ten years.

It is being said that a man's productivity is no longer measured by the clock, but rather by the capacity and efficiency of the tools and machines he operates. It must be pointed out, however, that a qualifying factor creeps into the picture right there, which is that in order to maintain a high production economy those tools and machines of increased efficiency must be kept busy by busy operators. The extent to which this is not done endangers the low costs, low prices and high wages that everybody wants.

It is the job of capital to provide the new and more efficient plants, processes, tools and machines that enable labor to produce so much more goods at such lower costs and selling prices that those higher wages can be paid.

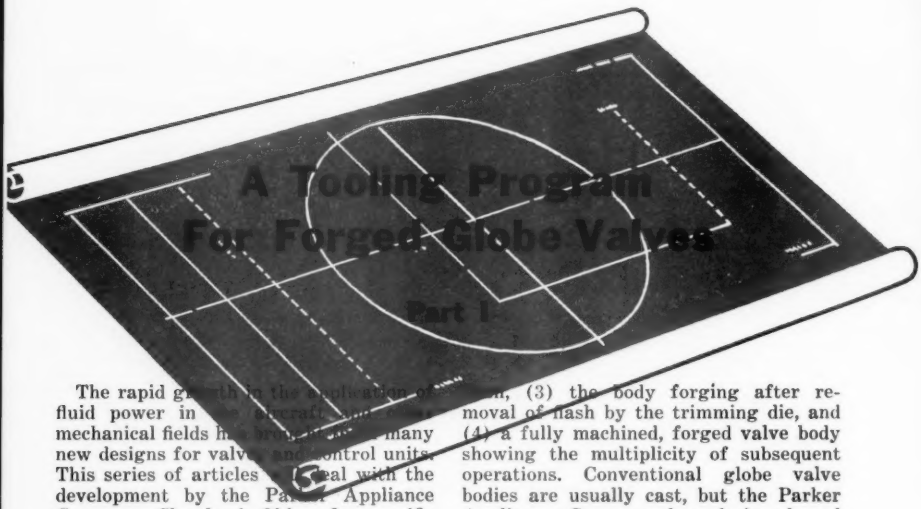
Labor pays itself by what labor produces. That economy is endangered if capital has made it so easy for labor to produce more that labor, aided and abetted by the frailties of human nature, tends to produce less. Regardless of how easy it is made for a man to produce, he still must produce all he can during all his working hours in order to enjoy the full benefits of his labor.

The fundamental laws of economics, based on supply and demand, are not man-made laws, but, insofar as they have been obeyed, they are the laws that have made this country as great as it is on all counts: freedom, opportunity and wealth.

They are laws that can be obeyed only by a busy people.

E. Willard Pennington

editor



A Tooling Program For Forged Globe Valves

Part 1

by Carl F. Benner
Assistant Editor

The rapid growth in the application of fluid power in aircraft and many mechanical fields has brought many new designs for valves and control units. This series of articles will deal with the development by the Parker Appliance Company, Cleveland, Ohio, of a specific brass globe valve for hydraulic application and will follow the steps in producing the body and all its various components. It will describe in detail the entire tooling program and the methods used in building the tools, dies and fixtures for the complete sequence of forging, trimming, milling, drilling, threading, chamfering and broaching operations. This first installment will treat the procedure followed in manufacturing the forged body of the brass, offset, globe valve.

In Figure 1 is illustrated the several workpieces representing, left to right, (1) the cold-drawn brass forging billet or slug, (2) the initial forging with flash, (3) the body forging after removal of flash by the trimming die, and (4) a fully machined, forged valve body showing the multiplicity of subsequent operations. Conventional globe valve bodies are usually cast, but the Parker Appliance Company has designed and developed globe valves with forged bodies, because the denser grain structure of the forging results in a finished valve which will withstand much higher

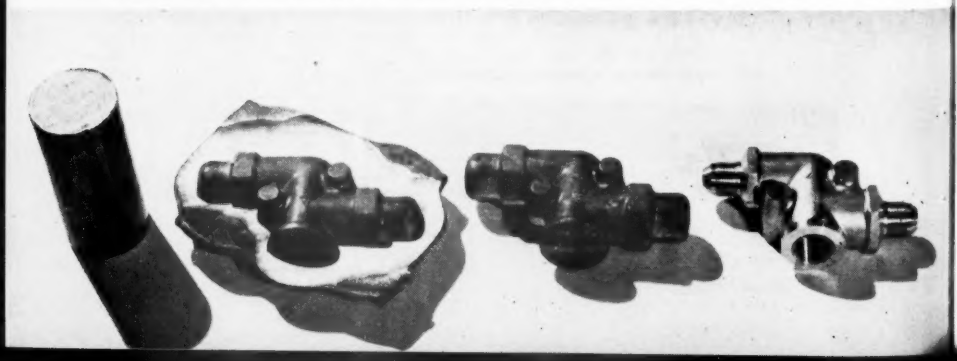


Fig. 1. A display of four workpieces representing different stages of manufacture of the forged valve body. Shown from left to right are (1) the cold-drawn brass forging billet or slug, (2) the initial forging with flash as it came from the forging press, (3) valve body forging after removal of flash by trimming die, and (4) a fully finished forged valve body showing the variety of milling, drilling, threading and chamfering operations subsequently performed.

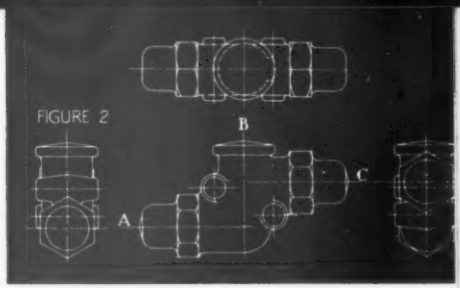


Fig. 2. The body forging for a Parker Globe Valve. This is designed specifically for machining from the solid. It can readily be seen that the many machining operations that can be performed in relation to the centerlines A, B, and C contribute to the economy and simplicity of manufacture. The entire tooling program for this valve and its fixtures "grows" from these centerlines.

pressures without leaking than cast valves, since cast materials are more porous than forged. It is well to mention here that the forging billet or slug is of cold-drawn brass stock, because, if the valve body were forged from a cast billet there would still be an inferior grain structure, and the danger of foundry sand and surface crust inherent in cast metals would shorten the life of the forging and trimming dies. Most important, therefore, to the successful forging of this piece is the ideal, dense grain structure and uniform plasticity of the cold-drawn brass used as the forging stock.

The specified operating characteristics and applications required of this valve are incorporated in the design of the body forging as shown in Figure 2. The flexibility of the valve body design permits finishing the valve to any one of several combinations of style and size of fittings for the two ports. For example, the ports can have: external threads, internal threads or tube fittings in any combination and in a wide range of sizes. The offset feature of the design results in simplifying both the forging die construction and the machining operations performed on the forged body. Centerlines A, B, and C of Figure 2 indicate the ease and simplicity of removing a large amount of material by three drilling operations. This compares with the intricate pattern and core construction that would be involved in the case of a cast body. No dimensions appear on the drawings, because sizes are not a consideration in this discussion.

Master Die

Master dies, or master blocks, for the body forging are designed and built from the dimensions which would ordinarily be shown on the forging drawing, Figure 2. It is the policy at Parker Appliance Company to build a master die block for every forging die; then all other subsequent dies and fixtures are duplicated from, or made in reference to, the master blocks.

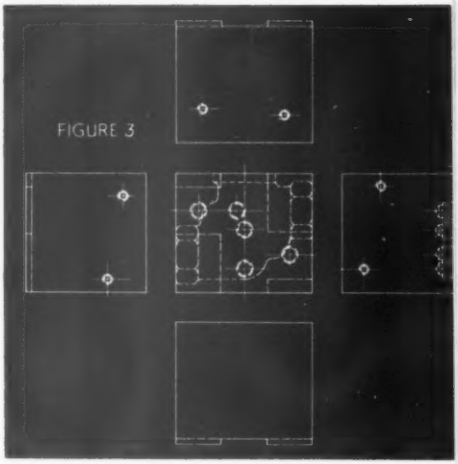


Fig. 3. One of the two halves of the master forging die block assembly. The dotted lines show the relationship of the keyways to the centerlines of the valve body.

The design of this body forging enables boring operations to be employed for removing the larger part of the material from the master die cavity, instead of "hogging out" on the milling machine. The two halves, A and B, of the master die block, Figure 3 and Figure 3-A, are made from two pieces of cold-rolled steel. A pattern of keyways, C, is cut in the surface of each block opposite the cavity face. The purpose of the keyways is for holding and locating the master die block assembly while the cavities are being bored in the two halves. The boring of the master die block is done on an engine lathe with a Goss & DeLeeuw two-jaw chuck bolted

to the face plate of the lathe, and with the drilling and boring tools set in the tail stock, Figure 4.

Because some of the final machining on the forging blank is done on the Goss & DeLeeuw chucking machine, a Goss & DeLeeuw chuck, D, Figure 4, is used on the engine lathe for holding the master blocks during the cavity boring operations. The keyways, C, serve as reference or locating planes for a number of the operations which follow, hence, utilizing them for positioning the master blocks in the Goss & DeLeeuw chuck for boring the cavities assures perfect alignment of the forged body in the Goss & DeLeeuw chucking machine for the finish machining operations. The centerline of each keyway is parallel to, and in the same plane as, the centerline of a corresponding bored cavity in the body of the master die.

In other words, the master forging die blocks are held for boring by Goss & DeLeeuw chuck jaws, E, Figure 4, engaging keyways in the master blocks. From these master blocks or dies the work forging dies are made on a Gorton duplicator, and here again the importance of the keyways must be appreciated. The tool steel blocks in which the cavities are to be reproduced are centered on the Gorton by reference to the keyway centerlines in the master blocks. This insures that the centerlines of the forged body produced by the working die will correspond to locating keyways provided in the subsequent work-holding fixtures. By the same token, the flash trimming dies, also made by reference to the initial master blocks, have their centerlines in common with the centerlines of the forged body as it is positioned for trimming. This same registration of work

FIGURE 3-A

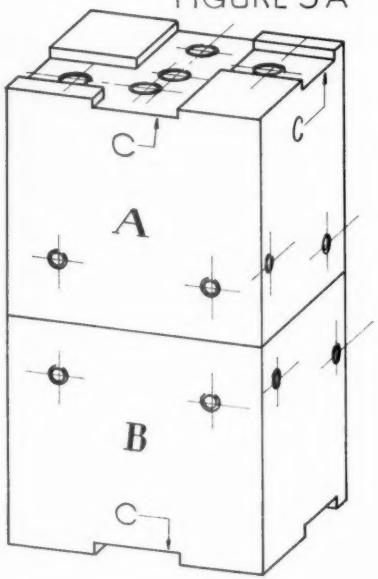


Fig. 3-A. The two main blocks that comprise the master die halves in perspective. As held for boring along the centerlines A, B and C of Fig. 2, the metal that is removed leaves half-cavities in each block because the three centerlines are in a plane that corresponds to the meeting faces of these two blocks.

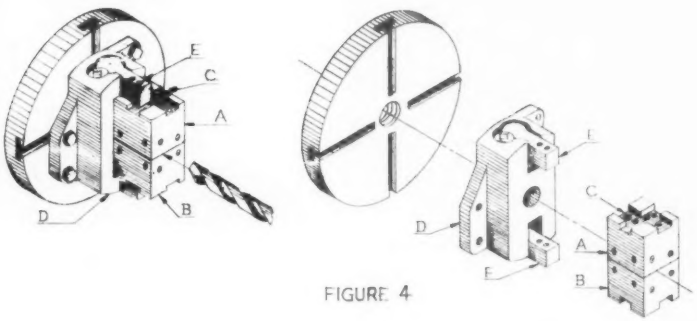


FIGURE 4

Fig. 4. Showing the two halves of the master die block clamped between the jaws of the Goss & DeLeeuw faceplate fixture. The jaws engage and locate the work by means of the keyways as shown. To drill and bore along the three centerlines shown in Fig. 2, the master die block halves are successively located in the chuck by three pairs of keyways. For each boring operation the work becomes positively located so that the drill centerline is parallel to, and in the same plane as, the centerlines of each respective pair of keyways.

centerline with fixture centerline is assured throughout all subsequent operations by reference to, and utilization of, the master keyways.

In this particular offset valve body there are three openings, i.e., two ports and a top opening to admit the valve stem. Therefore, three keyways are cut in the surface of each block opposite the surface that is to receive the forging cavity; one keyway for each of the ports and one for the top opening. After the two blocks have been prepared with keyways, they are positioned in the Goss & DeLeeuw chuck which is mounted on the lathe faceplate, and clamped by means of the chuck jaws engaging one set of keyways. They are held secure in the chuck by two setscrews in each jaw. The centerline of the chuck is in alignment with the spindle of the lathe, so that when the master blocks are positioned in the chuck the centerline of the cavity to be bored is common to the axis of rotation. On this particular master block, three boring operations are performed; one from each end and one from one side. Successively positioning the blocks in the chuck by means of the keyways results in the three cavity holes being bored accurately. These three boring operations remove most of the material for the cavity. The cavities for the mounting bosses are drilled out with a taper drill, since the bosses have a slight taper for draft. The hex shapes on the ports are milled out, and the top cavity is enlarged by counterboring. These operations are performed according to the dimensions on the forging drawing. Figure 5 shows, in perspective, the two body halves of the master die block assembly. The openings, F, G and H, result from the initial drilling and boring operations performed on centerlines A, B and C, Figure 2, and the milling of the hex shapes surrounding the ports. Figure 5-A shows a plan view of the master forging die cavity.

To complete the master block assembly, there are two end plates, I and J, and one top plate, K, Figure 6, attached to the main blocks. The cavities that form the bosses on the ends of the ports are counterbored in these end plates. The cavity in the top plate, which forms the top of the body, is milled out with an

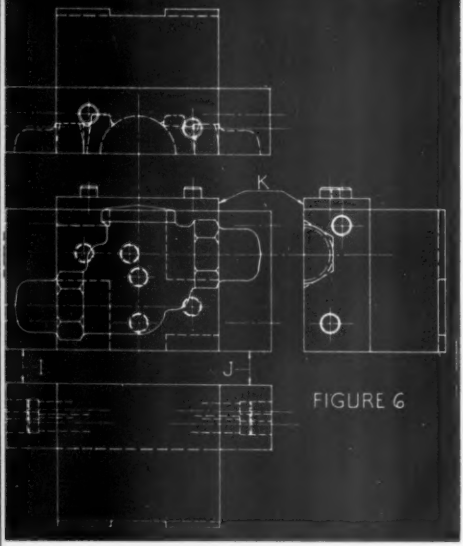


FIGURE 6

end mill having a 166° included angle on the cutting end. These cavities are all machined from print dimensions.

All parts making up the master block assembly are case-hardened by the cyanide process.

(To be continued)

Fig. 6. Two end plates, I and J, and one top plate, K, are counterbored and milled as shown and then attached to each main block to complete one-half of the master die cavity. Each master die half as shown here is used on the Gorton duplicator for producing the corresponding half of the work forging die.

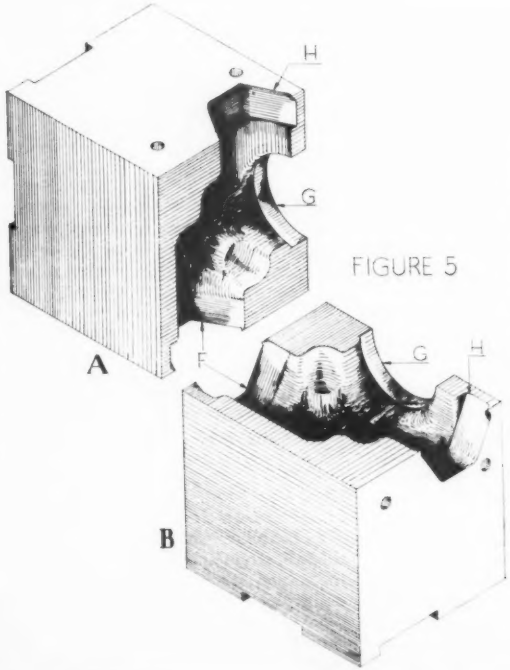
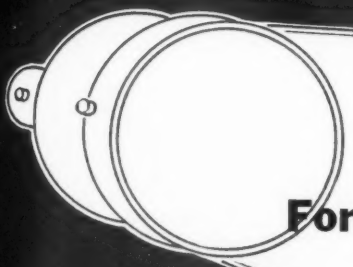


FIGURE 5

Fig. 5. Perspective view of the two body halves of the master die block assembly. The two halves of the cavity have been produced by the initial boring operations corresponding to the centerlines A, B and C of Fig. 2. The final correct hex-shapes of the openings F, G and H are produced by milling. The small cavities in the blocks that produce the mounting bosses on the forged valve body are taper-drilled to provide the necessary draft.



Milling-Cutter Design For Continuous Production

by Arthur A. Schwartz
A. S. M. E.
Buffalo, N. Y.

The milling machine has been much further developed than its milling cutters. Reviewing the conditions existing today, it can be said that the carbon-steel milling cutter is ancient in design but still the best for use on the softer metals, such as aluminum, brass, and magnesium, as to speed of chip removal, tool life, and finish.

Besides the carbon-steel cutter, the most common cutter is of the high-speed-steel type. In looking over some of these cutters, one that has never been used can be found lying next to its duplicate, apparently of the same size. Using a micrometer, and measuring the outside diameter of each, the chances are eighty out of a hundred that they will vary by several thousandths. If a pair of slotting cutters were put to work there would be only a slight chance of obtaining two slots having the same dimension.

Looking at another pile of cutters, it will be found that some are sharp, some are dull, some have been through a salvage operation. They all fit in the same category: Not good enough to keep and too good to be thrown away.

About five years ago a drive was started to eliminate excess teeth in milling cutters and substitute cast- or soft-steel bodies with brazed-on teeth of any preferable cutting material. The slogan those days was: A healthy bite for every milling-cutter tooth. The number of teeth was limited by the amount of material that could comfortably be handled by the motors and spindles of the machines without overloading and still make the feed such that each tooth would get a healthy bite. This was confirmed by tests made by O. W. Boston at the University of Michigan which proved that the tooth that took a bite of from 0.002" to 0.010" performed better and had double the tool life of the tooth that just skidded and slipped over the work.

Since then many such cutters have been made, advertised, and sold and many a foreman and old employee has been converted. That is why few cutters of this type are found hanging in the tool crib. Most of them are out on the job or are in the grinding crib awaiting their turn to be sharpened.

One more type of cutter that should be mentioned is the inserted-tooth cutter. Every one of these is the best that can be made of this type of cutter, particularly as regards the way the blades are inserted and held—so say the manufacturers of the cutters. The manufacturers may be correct, but this author has yet to see the perfect lock for an inserted blade. Most of these cutters are fine tools and they are a step ahead of

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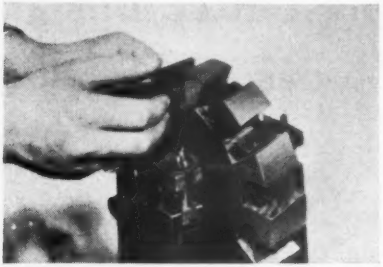
Fig. 1. Grinding Fixture Showing the Slots for Receiving Blades.



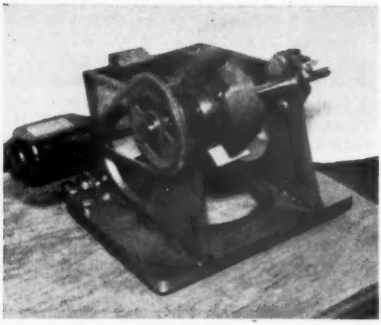


Fig. 2. Fixture for Holding and Spinning the Grinding Fixture.

the old, solid one-piece cutters that wasted so much good cutting material. They also have excess teeth; but instead of knocking them out—just omit putting them in.

In the grinding crib one or two operators may be seen grinding drills, others are grinding lathe tools, and the expert is grinding broaches or form tools; but most of the operators are grinding milling cutters. Why is so much time spent on milling cutters? Are the mills the predominating machines in the shop? Far from it. It is because of the long time necessary to grind a cutter and the short life of the tool between grinds.

When a milling cutter dulls, a freshly ground one replaces it. But the freshly ground cutter does not have the same dimensions as the dulled one. Furthermore, it will not seat on the arbor as the other one did. When a reground or new cutter is put to work the machine must be ready to turn out the same work that it did with the previous cutter. From year to year working tolerances are becoming closer. More accuracy is being called for, and it is a time-consuming job to set up a milling machine to hold close tolerances. Hence to set up a cutter in a milling machine takes time.

This is the picture of present-day milling. The facts presented can be easily checked by anyone. However, another category of cutters should be added to those already in the crib, one that will help make the milling machine a true production tool by reducing the time required to set up, and the time required to sharpen the cutters.

To achieve this much desired result three provisions are necessary:

(1) A newer, quicker, and simpler way to sharpen the cutters in order to eliminate at least 80 percent of the time now required.

(2) A simple system of blade insertion and locking that will make it possible for the new blade to seat exactly as every other blade of the series would seat and eliminate 95 percent of the set-up time now required to change cutters.

(3) A way to make precision grinding of the blades and the production of the blades rapid, simple, and easy.

Undoubtedly these results can be achieved in many ways. It is hoped that interest will be aroused so that some of the shops will try to achieve them.

At Bell Aircraft Corporation a system has been developed which is thought to be good. Experiments and tests have proved that it works. It was found that the three provisions just mentioned were absolute "musts".

A separate grinding fixture, Figure 1, is provided with as many blade slots as possible. All the slots are alike in dimensions, angle, and radial distance from the center. Another fixture is provided, Figure 2, for holding and spinning the grinding fixture. This is the grinding setup. The blades are given a circular, rough, and finish grind. Shapes and contours may be determined by a template attached to the fixture, which operates against a nib, representing the

grinding wheel which is fastened to the table of the grinding machine, as shown in Figure 3. A better way is to use a drawing or photograph of the contour in a special comparator attached to the grinding fixture.

Always the first step in cutter grinding and familiar to all grinders, this one operation completes not only one cutter but two or more, depending on the number of blades used in the cutter and the number held at one time by the grinding fixture. Suppose the cutter used four blades and the grinding fixture held sixteen. It would mean the complete grinding of four cutters during the time now spent in circular-grinding one cutter. The estimate of 80 percent saving in grinding time is conservative indeed.

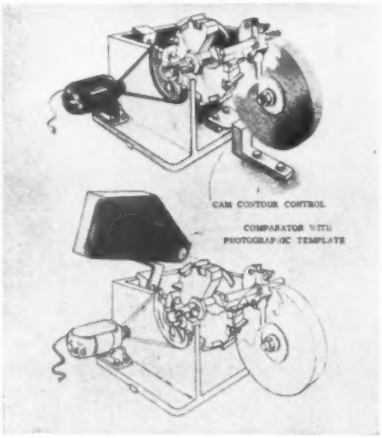
All four slots of the cutter body also must be alike in dimension, angle, and radial distance, and there must be a 5° angular difference between the slots in the cutter and the grinder, both radially and axially, so the blades sit up 5° straighter in the cutter. (See Figure 4.) This change of position gives the clearance. University of Michigan tests indicate 6° to 7° as the best clearance, but that was grinding in the old way which was a series of reverse curves. Here attention should be called to the "land" that is left on most cutting tools that travel or cut in a circle. This land which is really part of the original circular grinding, no matter how narrow, still prevents the tool from advancing in the work. It slides under heavy pressure and generates heat where heat can do the most damage—at the cutting lip of the tool. In milling cutters and similar cutters more than 25 percent of the detrimental heat and about 25 percent of the pressure required to advance the tool into the work are caused by this circular land. In common grinding practice it is impossible to eliminate this land without spoiling the contour. Years ago lands had to be stoned by hand in order to create a little clearance; but the stoning had to be done by experienced machinists, the kind that are scarce today.

Recently a special router bit was made which had to be hand-held and operated. A 2 hp, 21,500 rpm motor weighing about 5 lb was used. When the bit was ground with a land as made by all the router-bit makers, a feed of 20" per min. was about maximum for an average man. With careful stoning this was raised to better than 60" per min.

Following is a good illustration of the importance of the relief angle up to and meeting the cutting edge.

This system of grinding with the blade at an increased (if positive) or decreased (if negative) axial and radial angle automatically produced the ideal edge

Fig. 3. Contour Grinding Controls.



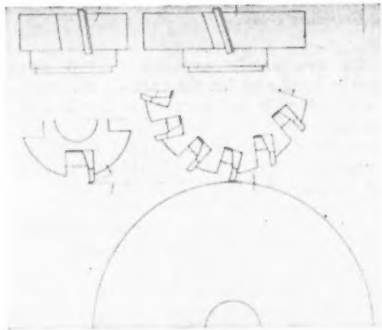


Fig. 4. How Clearance Angles are Obtained. (A slab and slide mill combined is shown from which it can be seen that either type of cutter can readily be made by this system.)

clearance—actual relief with the maximum lip strength.

The milling research conducted recently in Michigan and California has time and again mentioned cutting-edge chipping and grinding cracks in or near the cutting edge. With present methods of grinding these are difficult to avoid, and when they appear they generally render the cutter inoperative in a short time.

Using this new system of grinding, cracks are easily avoided. Even extremely hard and brittle carbide can now be ground with due care as to feeds and sparking out; and the relief not only meets the cutting edge without chipping or cracking, but a smooth shiny surface that extends the tool life is obtained.

Fig. 5. Interchangeable Blade Milling Cutter and Grinding Body.

If there were no other reason for the adoption of this system, this fine cutting edge alone would make it profitable.

It may be said that it takes two surfaces to make an edge and that is true. With the present system of grinding, each blade face must be ground individually when it is in an almost inaccessible place.

This face of the blades should be ground and polished before the blades are cut from the bars in which they come. This grinding is done in multiples by means of the magnetic-chuck surface grinder, an almost ideal operation.

In order for these blades to operate at a high efficiency it was necessary to hold them solidly in the cutter body, to back them up against breakage, and to arrange it so that they could be quickly and easily extracted and inserted.

Figure 5 shows how this problem was solved. The blade is of very simple construction—a wedge-shaped piece of metal held in a plain slot by an opposing wedge. All cutting forces act against two smooth planes at right angles to each other, and it is not necessary to remove the wedge block as the blade will slide out freely and the new one take its place. This sliding motion helps to prevent misalignment caused by chips. Free egress is left for chips and either a little air or coolant will clean out the slot to assure proper alignment of the sharp blade in "identical" position with the dull one. The word "identical" is emphasized as much as possible in that the size of the blade need not be known since that is taken care of by the first setup of the mill. All that need be known is that the new blade have the identical measurements of the dull blade.

To make things identical with this system it is required to cut only the slots in cutter and grinding body each at one setting of the milling machine, and to grind all the blades either to template, or comparator, or both.

The Broaching of Brasses and Bronzes

Part I

by Harry H. Gotberg

Chief Engineer

Colonial Broach Company

Detroit, Mich.

The increasing use of broaching as a method of metal removal in a wide variety of industries is due chiefly to the fact that in most cases, broaches can do the job faster and at less cost than any other tool. This has proved to be as true in the machining of copper, brasses, and bronzes as in the machining of cast irons and steels.

The reason that a broach can remove metal so fast and so accurately is that the tool is composed of a large number of individual cutting teeth each of which does its specific share of the work, no more, no less. This is accomplished because each successive tooth on a broach cuts just a little deeper than the one immediately ahead of it, as shown in Figure 1. In other words, the correct cutting feed is actually designed into the tool, and is a function of the tool rather than of the machine.

Thus in one pass, broaches are able to rough, semi-finish, and finish holes or surfaces of regular or irregular shape. The first group of teeth, Figure 1, does the roughing. The middle group does the semi-finishing, and the last teeth finish the work. The step per tooth (feed) is generally greater in the roughing section than in the finishing section. In addition, the roughing teeth do not necessarily have the same general form as the finishing teeth.

The finishing teeth of a broach, of course, must be exact replicas (as to cutting profile and dimensions) of the blue-print specifications which the tool is to produce. They "generate" the final form. Roughing teeth, on the other hand, may be designed so as to distribute most economically and effectively the job of removing surplus metal prior to finish broaching. Hence, the shape of the roughing teeth may represent more nearly the initial contour of the casting or forging being broached than the finished work profile.

Broaching possesses certain other inherent advantages besides that of speed. Tolerances measured in tenths of a thousandth are not unusual on some production runs. Again, broaching often eliminates other methods of machining. Many operations are currently being performed with a single pass of a broach that would require several operations by other machining methods. In addition, average tool life and life per grind of a broach is comparatively long, due to the large

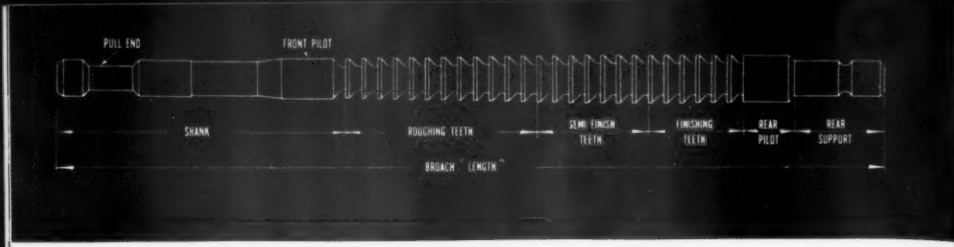


Fig. 1. Broach nomenclature.

number of cutting teeth in each broach and the small amount of work each tooth performs in a single pass.

As for the broaching of copper, brasses, and bronzes, all commercial types of these metals can be broached on standard broaching equipment with little or no trouble provided that ordinary precautions are exercised throughout. The same types of machines used for broaching steels and cast irons are used for working the copper base alloys; the broaches themselves require only minor modifications dictated by the characteristics of the brass or bronze being broached. Broaching speeds tend to be in the upper range of machine capacity; cut per tooth is usually somewhat greater than on steel; and even longer tool life is obtained when broaching brass than when working steel or cast iron.

Machinability of Copper, Brass, and Bronze

Just as no one brass or bronze can meet all requirements, so no general laws as to machinability of these materials can be set up. The addition of one or more closely controlled alloying elements to give brasses and bronzes increased strength and wear resistance; and of other elements to produce readier weldability, etc., has brought about an equally diversified range of machinability extending from free-cutting yellow brass all the way to pure copper and extremely tough bronzes.

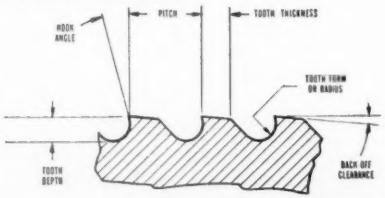
In general, the machinability of both copper and the copper base alloys increases noticeably with the addition of small percentages of lead (usually from 1% to 4%). Thus, pure copper (one of the most difficult metals to machine due to its softness and extreme tenacity) can be cut two or three times as fast when but 1% lead is added, thus putting it almost on a par with free-cutting leaded brass. A few of the wrought bronzes are nearly as easy to machine as free-cutting brass. On the other hand, a number of bronzes resemble mild steel in their cutting characteristics.

In order to classify roughly the relative machinability of copper, brasses, and bronzes, these metals may be placed in three general groups. Naturally, any line of demarcation between groupings cannot be clear-cut, but the following groupings are, however, a reasonable guide to machining characteristics:

Group 1: Free-Cutting Alloys. Usually brasses with a small percentage of lead. Free-Cutting Yellow Brass (62% copper; 34½% zinc; 3½% lead) taken as base line, or 100. Group includes those alloys with ratings between 70 and 100, such as leaded copper; forging brass; leaded naval brass; hardware bronze; etc. These alloys produce short, brittle chips.

Group 2: Readily Machinable Alloys. Have a machinability rating of 30 or more, but less than 70. Includes nonleaded brasses; Muntz metal; naval brass; Tobin bronze; leaded phosphor-bronze; leaded silver nickel; etc. These metals produce fairly long chips.

Fig. 2. Tooth spacing, or "pitch" has an important bearing on length of cut and chip thickness which the broach will handle. It also determines number of teeth in contact with the work at one time.



Group 3: Alloys More Difficult to Machine. Alloys with a machinability rating of less than 30. Includes nonleaded coppers; nickel-silvers; phosphorbronzes; beryllium copper; chromium copper; etc. These alloys usually produce long, tough, stringy turnings.

Broach Design

A broach is one of the most carefully and precisely engineered of all cutting tools used in modern production. The dimensions, shape, spacing, and other elements involved must be exactly right for every tooth of the unit. The increase in diameter or contour of each successive tooth must be such that each does its proper share of work on the part for which it is to be used. Hence the length of cut, the material, the profile of the hole or the surface area must be known before either length of broach or capacity of broaching machine can be specified.

Conversely, if a broach is to be used in a machine which is already in service, necessary calculations must be made to determine whether all of the metal involved can be removed in one pass or if several passes will be needed; and also whether the machine capacity is sufficient, and if the proper finish can be obtained, etc. Unless these factors are known and considered, the quality and accuracy of the results may be less satisfactory than when every element of the operation is thoroughly understood.

Broach Strength. Assurance of adequate strength is a most important consideration in broach design. The strength of pull-broaches is determined by the area of smallest cross-section. This is usually at the root of the first roughing tooth, or at the pull end. In push-broaches, the weakest section is usually in the middle of the broach, since in this case the tendency would be for the broach to buckle.

Thus, broach strength should be taken into consideration when applying broaches to specific machine types and sizes. In general, allowable machine pull in psi for HSS pull-broaches can be quickly calculated as follows:

$$\text{Allowable Pull} = A \times K$$

Fig. 2-A. Correct and incorrect chip formation.

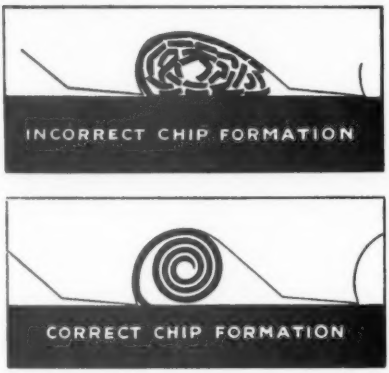
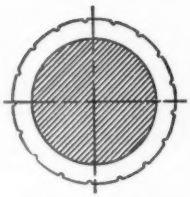
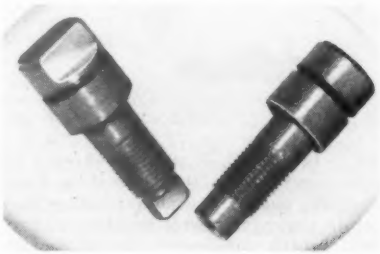


Fig. 3. To break up wide chips, broach teeth should be "nicked" as shown here. These "chip breakers" are circumferentially staggered on successive teeth.



where A is the area of smallest diameter of broach (usually root diameter at the first tooth) and K is a selected value *below* the tensile strength of the broach material, the actual value of K depending on the particular safety factor desired. Thus, if tensile strength is 120,000 psi and a safety factor of

Fig. 4. Double flats are broached on both ends of these bronze studs, six pieces at a time, on a Colonial Universal Horizontal Machine. Using a trunnion fixture, the work is loaded and unloaded during the return stroke of the broach.



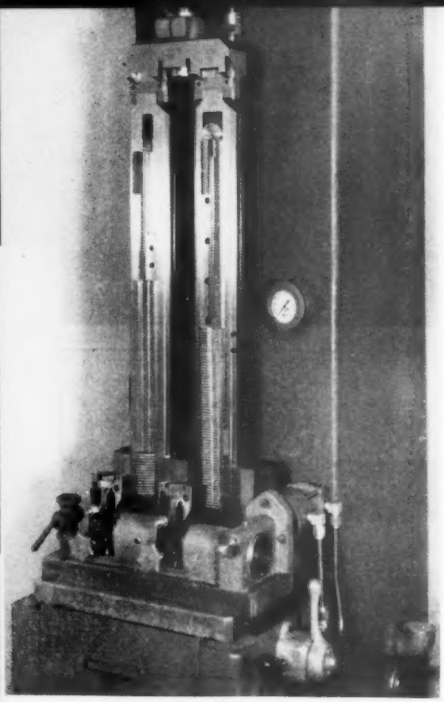


Fig. 5 and 5-A. Copper circuit breaker arms of complicated contour are broached from rectangular blanks on Colonial Utility Press. Each of the two work stations of the air-operated trunnion fixture takes 8 pieces for broaching at one time. Work is supported on a soft plate also broached to finished contour. Machine is shown in loading position. Production with this setup is 800 to 1000 finished breaker arms per hour.

100% is desired, K will be 60,000. In this regard, it might be well to state that the use of a generous safety factor is always desirable in order to prevent broach damage in case of sudden overloads due to the teeth encountering hard spots, etc.

Pitch. Tooth spacing, or "pitch", Figure 2, has an important bearing on length of cut and on chip thickness which the broach will handle. It also determines, of course, the number of teeth in contact with the work at one time. A formula frequently used to determine desirable pitch is:

$$\text{Pitch} = .35\sqrt{\text{Length of cut}}$$

In any event, care should be taken to see that at least two teeth, and preferably three or more, are in contact with the work during the cut. If machine capacity is inadequate to handle this combination of length of cut and pitch, the best method of lessening the pull on the broach is to reduce the step per tooth rather than to reduce the number of teeth in contact with the work (by increasing the pitch).

Sometimes vibration during broaching, or the production of annular marks in hole broaching, are traceable to a varying number of teeth in contact with the work during one pass. This effect is due to the changing resistance as one tooth leaves the work before or after another tooth has entered. Spacing teeth differently, as in groups of two or three, greatly reduces this type of vibration. Difficulties from this source are less frequently encountered in surface broaching, except when the broach is cutting more than one surface on a part, or cutting several parts at one time.

When surface-broaching several brass or bronze parts at one time, it is usually desirable to avoid having teeth for different surfaces engage the work simultaneously. Broach inserts should be so mounted as to stagger the engagement.

Face Angles. The face angle, or "hook", of broaches, Figure 2, for cutting the general run of brasses and bronzes, ordinarily ranges from 0° to 10° or even more, increasing with the ductility of the particular alloy being machined. Brittle materials call for small angles. Brittle brasses, for instance, require a hook of from —5° to +5°. Therefore, frequently it is possible to use broaches without any hook on such short chip brasses and bronzes.

Shear Cutting. In "shear cutting", the teeth of the broach are at an angle (usually 5° to 20° from the normal 90°) to its direction of travel. This eases each tooth into the cut and provides smoother cutting action, thus eliminating vibration and improving surface finish. Shear cutting is frequently used for the surface broaching of brasses and bronzes. It should not be used for broaching deep slots since the chips will be forced against the side of the slot, tending to roughen the surface.

Tooth Thickness. This dimension is, to a considerable extent, a function of broach life since it determines the number of times a broach can be reground before reducing the thickness of the tooth at the cutting edge too much to properly withstand cutting stresses. Optimum tooth thicknesses to give best tool life have now been fairly well standardized in relation to the pitch of the broach. Tooth thickness should not be greater than what will allow for proper chip space for the pitch established for the particular length of cut. Inadequate chip space will result in incorrect chip formation, Figure 2-A.

Chips and Chip Breakers. The bronze chips produced by the teeth of a broach are not unlike those produced by single point cutting tools. In this connection, it is important to remember that a broach must, by its very nature, usually carry its chips with it until it comes out of the cut. This means that enough space has to be provided between the individual teeth to carry each tooth's chip load without crowding. Unless this is done, there is a chance of dulling or even breaking the tool, and roughing or tearing the work surface, etc.

In general, when broaching those brasses or bronzes that give a long or a continuous chip, the need for some form of chip breaker is indicated. Long or continuous chips are hard to control, particularly in round hole broaching where a continuous and growing ring would form if the chips were not broken. This is usually taken care of by having the teeth "nicked", as shown in Figure 3. Such chip breakers are staggered on successive teeth.

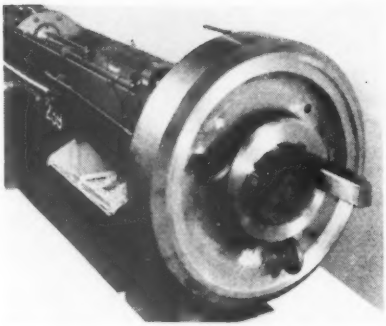
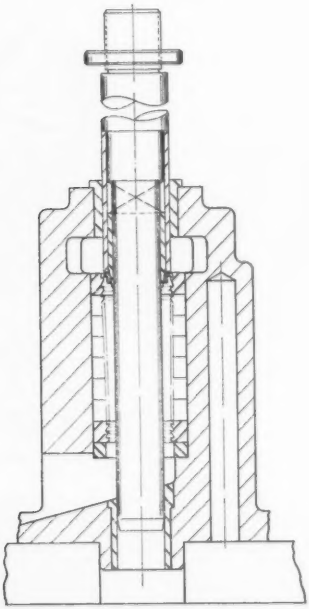


Fig. 6 and 6-A. Broaching Navy bronze. Where production is relatively light or workpiece unusually large, multiple, straight splines can be produced by indexing the work and cutting one spline at a time with a keyway type broach, as on this Colonial Horizontal. The broach is shimmed between cuts, the total stock removal being too great for one pass.

Clearances. Normally, the entire thickness of each tooth of a broach is backed off at a slight clearance angle, Figure 2. It is desirable to hold clearance angles to a minimum consistent with the job, in order to minimize loss of size when the broach is sharpened. For brasses and bronzes, the roughing teeth on the broach usually have a clearance of 2°, with 1° on semi-finishing teeth, and ½° for the finishing teeth.

Fig. 7 and 7-A. External involute spline teeth as broached on a brass synchronizer part for an automotive transmission. The pieces are pushed through the hollow broaching rings.



Cut per Tooth. Too heavy a step or feed will tend to overload the broach tooth, no matter what metal is being broached. Too light a cut interferes with the free-cutting action, increasing the tendency toward glazing, galling and tearing of the broached surfaces. Smaller steps can be used for the finishing teeth than for the roughing teeth. It is usually practical to employ a heavier step when broaching brasses and bronzes than when cutting steel.

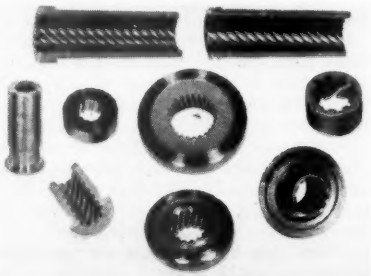
Pilots. In internal broaching, front broach pilots or guides should extend completely through the work before the first tooth enters. The guide thus also serves as a rough check on maximum stock which the first tooth will have to cut. Rear pilots should be ground with the minimum clearance possible in the finished hole so as to provide maximum support to the finishing teeth.

Springback. If the material tends to spring back during round hole broaching (as brasses and bronzes sometimes do), a burnishing tool on the end of the broach will sometimes function to "set" the metal, thus helping to maintain accuracy in the finish-machined part.

Figures 4, 5 and 5-A, 6, 7 and 8 are typical examples of the wide variety of copper, brass, and bronze parts currently being broached.

(To be continued)

Fig. 8. The helical splines in these bronze sleeves for aircraft starter units were broached on a Colonial Horizontal equipped with special guide bar and follower. In some cases helical splines in gear blanks, bushings, sleeves, etc., have to be held to such extremely close limits as can be obtained only by broaching.



*One session of the 2nd Quality Control Conference sponsored by the Federal Products Corporation and held at the company's plant in Providence, Rhode Island, September 10-13, 1946. The purpose of the Federal conferences has been to tie together the statistical theory and the practical application of Quality Control. That these "shirt sleeve" sessions of the conferences got down to brass tacks in exploring their subject is evidenced by one of the case histories brought up for discussion as follows * * * **

Quality Control Of Steering Gear Parts

This discussion was led by the chief inspector of a concern which supplies steering gear parts to a nationally known manufacturer of auto trucks. The inspector had a particular problem which involved a grinding job held to tolerances of plus or minus .0005", not too difficult a proposition on the surface. The plant, however, had been strike-bound for six months. All grinding equipment including the machines was in need of a thorough overhauling.

Any outsize, undersized or other defective pieces were discovered only when the steering gear assembly was completed in the purchaser's truck assembly plant. This meant expensive jobs of tearing down and rebuilding. The repercussions from defective parts reached the highest management levels of both the truck manufacturer's plant and the vendor's shop.

To meet the difficulty the chief inspector at the vendor's plant had set up a 100% gaging program covering the troublesome dimensions of the parts. At this point the management at the vendor's plant ordered a 33% cut of inspection expense.

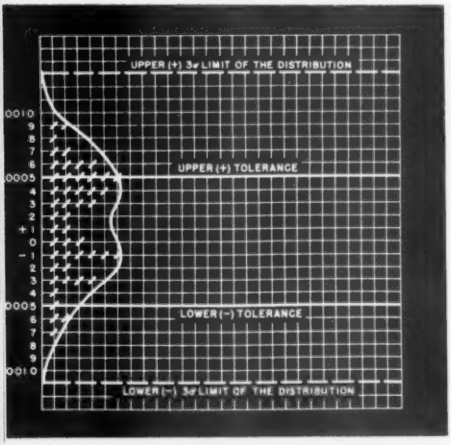
The specific questions presented to the Conference by the vendor's inspector were:

(A) "Can Quality Control methods provide some way by which I can be sure that not even one defective piece reaches the truck assembly line?"

(B) "Can I secure the above result, and eliminate one-third of my inspection expense?"

The first step taken to meet the problem was to secure samples, at random, of about 10% of each day's work from each machine. Where the so-called "distribution" of the pieces in the sample

Fig. 1. When the frequency distribution of variations in the work that was sampled from one machine resulted in such a curve as this in relation to the upper (+) and lower (—) tolerance there was no question as to the necessity for machine repairs.



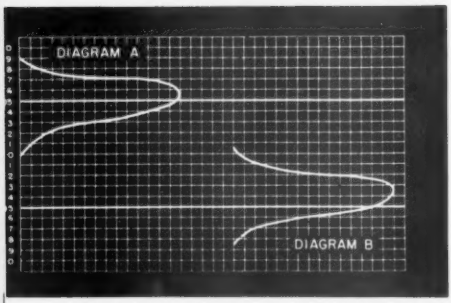


Fig. 2. Curve A shows work consistently produced within the prescribed limit of .0010 but greatly exceeding the + .0005" high tolerance. Curve B is of a similar sample running to the other extreme, i.e., both on the low side and exceeding the low tolerance.

showed curves and a relationship to the tolerance as illustrated in Figure 1, that particular machine was ordered out of commission and overhauled. The little "Frequency Distribution" made by the chief inspector's Quality Control engineer helped to sell production and maintenance supervision on the absolute necessity of machine repairs.

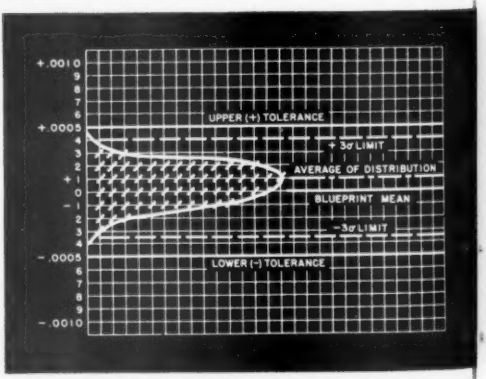
If the "distribution" from a machine showed results as portrayed by diagrams A and B, Figure 2, production supervision went to work on the operator. In this case the operator had a tendency to run his work either on the high side or on the low side, whereas if he had made a greater effort to stay nearer the "mean," 100% of his work would have been within specifications. The ideal distribution of the variations in the work is illustrated in the diagram of Figure 3. By "ideal" is meant that a surprising number of samples showed closely allied results.

In the way of real assistance to each operator, indicating type caliper gages were supplied; these were capable of showing variations, by indicator as fine as .0001". In addition, each operator was allowed time to make up one piece to very exact "mean" dimensions. This piece he thereafter used for a period as a "master" by which to set and check his own indicator gage.

Previously, one extra-sensitive comparator was located at the end of the grinding room. This instrument was carefully mastered and checked with gage blocks by an inspector several

(CONTINUED ON PAGE 114B)

Fig. 3. A frequency distribution curve showing an ideal distribution of the variations in the work. This was attained by furnishing each operator with an indicating gage and by a deliberate narrowing of manufacturing tolerances.



CTW
A CHAIN IS AS STRONG AS ITS WEAKEST LINK
A MACHINE IS AS GOOD AS ITS CUTTING TOOL...
Specify CONTINENTAL
The precision cutting tool must be even more accurate than the machine, the fixture, or the finished part. "Continental" cutting tools made by Ex-Cell-O (they run from a standard counterbore to all types of broaches and to special carbide-tipped tools of intricate design) are acknowledged to be among the best obtainable in design and manufacture and in actual production results.
CONTINENTAL TOOL WORKS
DIVISION OF EX-CELL-O CORPORATION
DETROIT 6, MICHIGAN

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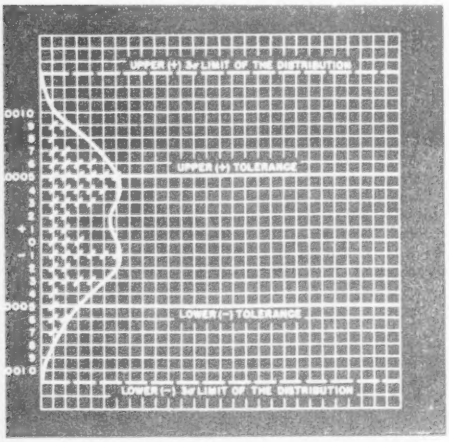

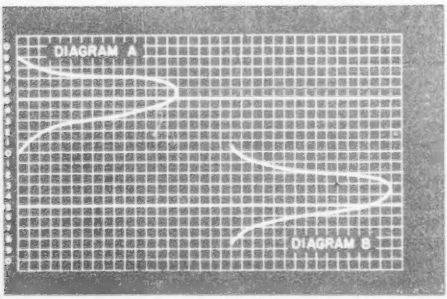

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(CONTINUED ON PAGE 110)

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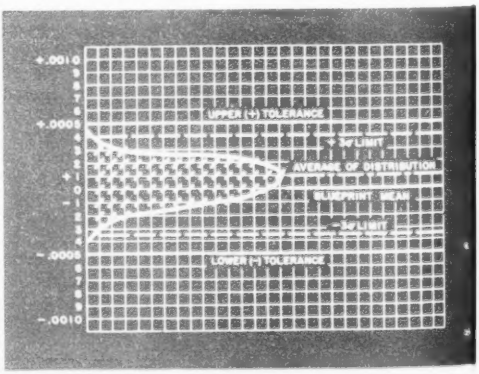
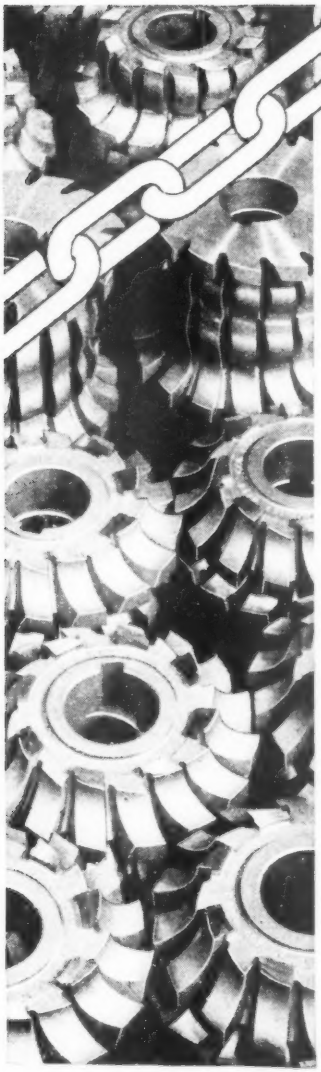




A CHAIN IS AS STRONG AS ITS WEAKEST LINK

A MACHINE IS AS GOOD AS ITS CUTTING TOOL...

Specify CONTINENTAL

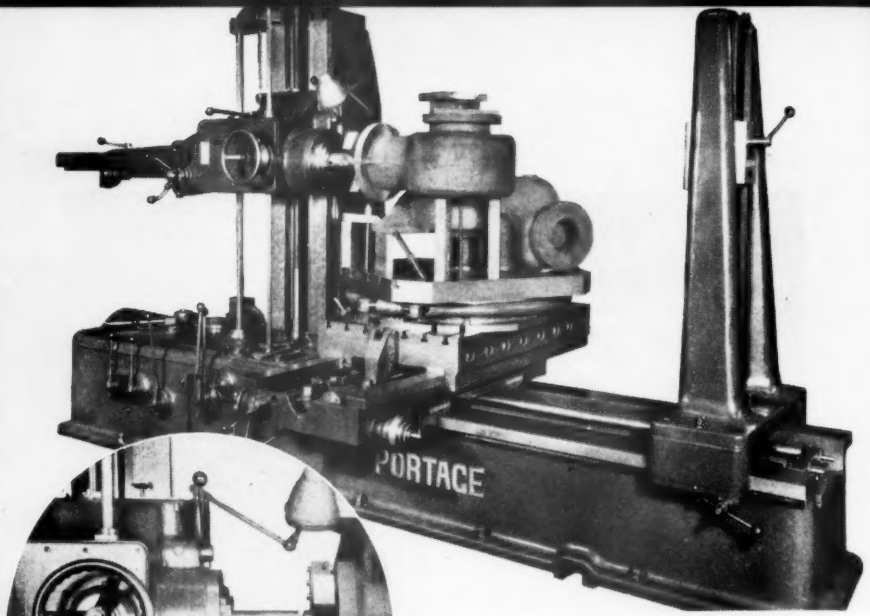
The precision cutting tool must be even more accurate than the machine, the fixture, or the finished part. "Continental" cutting tools made by Ex-Cell-O (they run from a standard counterbore to all types of broaches and to special carbide-tipped tools of intricate design) are acknowledged to be among the best obtainable in design and manufacture and in actual production results.

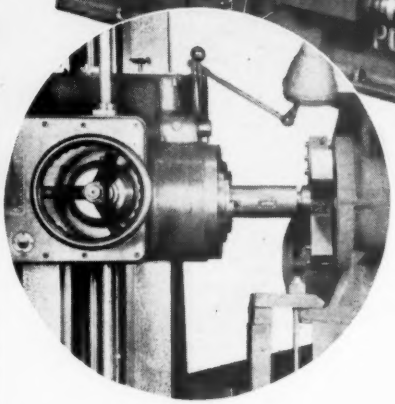
CONTINENTAL TOOL WORKS
DIVISION OF EX-CELL-O CORPORATION
DETROIT 6, MICHIGAN

CTW

Continental
CUTTING TOOLS

- Boring Bars and Tools
- Broaches Broach Pullers Broaching Fixtures
- Core Drills
- Counterbores and Countersinks
- CTW Drive Holders
- Counterbores (Tool Room Sets)
- Counterbore Pilots
- Inserted Blade Cutters
- Carbide Tipped Cutters
- Form Relieved Cutters
- Milling Cutters
- Thread Milling Cutters
- End Mills
- Side Mills
- High Speed Steel Reamers
- Carbide Tipped Reamers
- Shell Reamers
- Inverted Spotfacers
- High Speed Steel Tool Bits
- Carbide Tipped Tool Bits
- Circular Form Tools
- Cut-off Tools
- Flat Form Tools
- Dovetail Form Tools





The above photographs were taken in the plant of the Adamson United Co. at Akron, Ohio, and illustrate a job requiring boring, counterboring, facing and drilling at various angles, performed with one setup on a Portage Horizontal Mill equipped with a Portage 48" rotary index table. The Adamson United Co. reports their Portage operates with a maximum of efficiency and holds work to extremely close tolerances.

BORING • COUNTERBORING FACING AND DRILLING WITH *one setup on a* PORTAGE

FOUR OPERATIONS, AT VARIOUS ANGLES, WITH ONE SETUP is the rule, not the exception, for a Portage Horizontal Boring Mill.

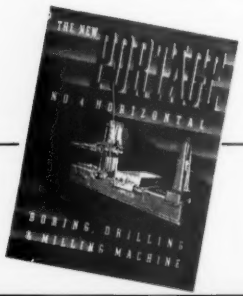
The exceptional rigidity of the Portage maintains "built-in" accuracy regardless of whether the spindle is at the top or bottom of the column and provides greater flexibility—greater economy.

One piece bed, with heavy ribs from floor line to top of bed, the Portage provides an exceptionally strong foundation for the column. The column, itself, is especially large, so that the area of its base plus the strength of the machine bed will provide exceptional rigidity for the spindle.

Extended saddles, rotary tables and numerous other standard accessories are available for special applications.

Portage specialists will assist you with your boring, milling and drilling problems. At no obligation, they will show you how you can save setup and production time, minimize fixture costs and get essential accuracy plus dependability with a Portage.

Phone, wire or write today



COMPLETE SPECIFICATIONS—and descriptions of the exclusive and unusual features of the Portage are contained in this booklet. Write today for your free copy.

PRECISION TOOLS AND MACHINES SINCE 1913

THE PORTAGE MACHINE COMPANY

1021-1035 SWEITZER AVENUE :-: AKRON 11, OHIO

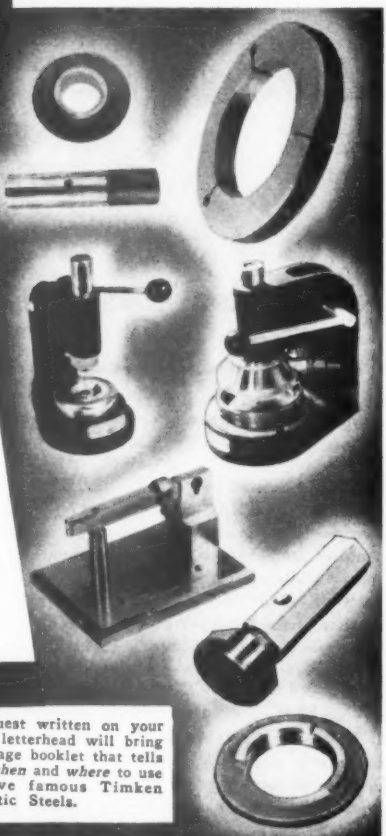
Blackstone 7191

Wearing Gages ARE MADE FROM GRAPH-MO STEEL

Few products demand the skill and accuracy that is required in the manufacture of gages. The steel from which they are made must be of equally high calibre.

Recognizing this fact is the reason that so many of the best known gage manufacturers are making gages of Graph-Mo Steel.

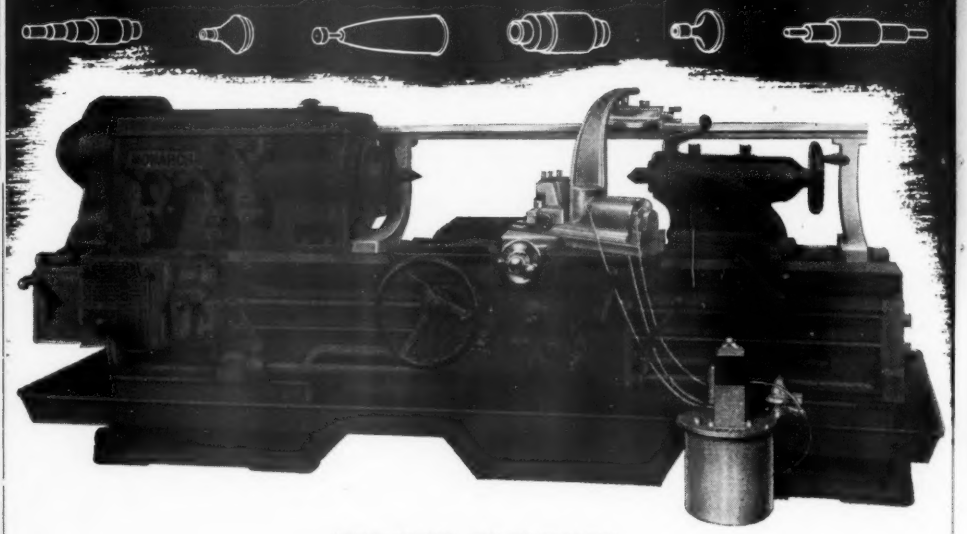
This oil hardening steel is one of the five famous Timken Graphitic Steels. It offers makers of gages many advantages because it resists growth, offers stubborn resistance to wear, is remarkably free machining and has exceptionally uniform response to heat treatment. Use these advantages to speed production of gages that will have long, accurate life. The Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.



TIMKEN
GRAPHITIC STEELS

A request written on your firm's letterhead will bring a 48 page booklet that tells *how*, *when* and *where* to use the five famous Timken Graphitic Steels.

FOR TURNING CONTOURS AND STEP SHAFTS



THE NEW EXCLUSIVE

MONARCH "AIR-TRACER"

FORMERLY KNOWN AS THE BAILEY DUPLICATING ATTACHMENT

Stepless increasing contours—machined to correspond to the template within a limit of tenths—and with a continuous finish that often eliminates grinding operations!

That's the kind of work you can do—*and faster*—with a new Monarch "AIR-TRACER" equipped lathe. You'll get greater precision—*greater production*—on increasing contours and on step shaft work, too. (Automatic sizing is an important integral feature.)

The "AIR-TRACER" has a proved production record for saving time, money and material on such diversified work as mandrels, punches, dies, nozzles, spinning chucks, impellers, valves, metering pins, molds—*and a wide range of step shafts.*

If you're doing these classes of work, you'll want to know all about the new Monarch "AIR-TRACER", offered exclusively on new Monarch Turning Machines equipped at the factory. You can get complete, detailed information in Bulletin 2601. Ask for your copy.

Check these advantages

- ★ **Stepless cutting-tool motion—for increasing contours and a superior continuous finish.**
- ★ **Air-gage sensitivity combined with hydraulic power's versatility and ease of control—an exclusive Monarch feature.**
- ★ **Automatic sizing eliminates repetitive setups and measurements—for faster production, fewer rejects.**
- ★ **Continuous feed of slide on increasing diameters—for more uniformly high finishes.**
- ★ **Exact conformance to template contours—changes in template shape translated instantly into slide movement.**
- ★ **Feed infinitely variable from 0 to 20″ per minute—for maximum machining efficiency on all materials and diameters.**

THE MONARCH MACHINE TOOL CO.
Sidney, Ohio

ACCURACY · ECONOMY · LONG LIFE
Monarch TURNING MACHINES

Tool And Die Manufacturers Make Plans For 1947

The first annual meeting of the members of the Tool and Die Industry under the auspices of the National Tool and Die Manufacturers Association, held in Chicago from October 23 to 26, was a very great success. Although organized during the latter months of the war this organization has numerous notable achievements to its credit. That this is recognized by its members is proved by the fact that they came from all states which have affiliated local tool centers. The Chicago Tool and Die Institute acted as host to the national members and the high character of the program events was a tribute to the cooperation between national and local officers and committees.

Everything about the convention testified to profound member interest in its activities. President Richard F. Moore's address of welcome recalled that in October 1943, three years ago, 83 charter members gathered in Chicago for the organization meeting. Since then, the membership has tripled and quadrupled until today it exceeds 400 and is moving steadily to this year's goal of 500. This membership growth Dick Moore frankly attributed to the untiring efforts of executive secretary George S. Eaton, who successfully enlisted the hearty cooperation of the principal local tooling groups.

by George J. Huebner
Editor-in-Chief
Huebner Publications

RICHARD F. MOORE
Retiring President, NTDMA
Recipient of Chicago Tool & Die Institute Award of Merit for distinguished service to Tool & Die Industry.
Recipient of honor award from fellow members of Connecticut Tool & Die Association.
President, Moore Special Machine Co., Inc., Bridgeport, Connecticut.

The Association's sound financial status then came in for special comment when Mr. Moore pointed out that a committee with Karl Harig as chairman set up a budget which provided for the successful development and operation of the Association within its income at all times. That this was unusually well accomplished became evident with the reading of treasurer Herbert F. Jahn's report that a net balance of more than $25,000 is on hand.

During the first years, because of travel restrictions, only quarterly direc-

PRINCIPLES OF BUSINESS CONDUCT FOR CONTRACT TOOL AND DIE MANUFACTURERS

Upon the Contract Tool and Die Industry rests the responsibility for supplying the special tooling which makes mass-production possible. This is a serious responsibility, since advances in living standards depend largely upon the use of better tooling for greater productivity at lower cost.

Relations between the manufacturer of special tooling and his customers should be on the highest plane of business conduct. This is especially true in view of the professional character of the services provided by the Tool and Die Manufacturer in helping the customer develop the most efficient tools of production.

Relations between the manufacturer and his competitors should be based on deserved mutual confidence and an earnest desire to cooperate in maintaining fair competition in the industry.

Relations between the manufacturer and his employees should be founded on unfailing fairness, and should reflect a sincere purpose to compensate the employee fully for the work performed.

The following ten fundamental truths will serve as practical guides for the conduct of a tool and die business in accordance with high principles:

I. THE FOUNDATION of business is confidence, based on integrity, fair dealing, efficient service and mutual benefit.

II. THE REWARD of business for good service rendered is a fair profit.

III. EQUITABLE CONSIDERATION and treatment are due customers, employees, capital, management and the public at large.

IV. KNOWLEDGE, thorough and specific, is essential to lasting success and efficient service.

V. CONTRACTS and promises should be carried out in letter and in spirit.

VI. GOODS AND SERVICES should be as represented.

VII. WASTE in any form of capital, labor or materials is intolerable.

VIII. CONTROVERSIES should, where possible, be adjusted by voluntary agreement.

IX. UNFAIR COMPETITION embraces all acts characterized by unfair practices.

X. LAWFUL COOPERATION among those in the industry in support of these principles of business conduct will make them a vital force.

UNFAIR PRACTICES

In the practical application of these ten fundamental principles, the following list will illustrate the types of unfair practices that should be scrupulously avoided in the day-to-day conduct of a tool and die business:

1. Knowingly making misrepresentations, or taking advantage of a customer's lack of information.
2. Giving quotations or guarantees of performance without full knowledge of costs and all elements affecting performance.
3. Refusing to discuss disputed matters in a spirit of friendly adjustment.
4. Giving money or anything of value with intent to bribe.
5. Failure to make reasonable charges for design service, or for contract cancellations, or to make unreasonable charges for such services.
6. Use of confidential information regarding a competitor's proposal to his disadvantage.
7. Accepting without verification reports that reflect upon the honesty of intent or act of a competitor.
8. Willfully discrediting the equipment, product, methods, personnel or credit standing of a competitor.
9. Enticing away the employees of competitors.
10. In times of manpower scarcity, paying exorbitant and unreasonable wages or salaries. In other periods, not adequately compensating employees.

tors' meetings and an annual meeting of duly elected delegates were held. The loyalty of officers, directors and delegates was evidenced by almost unfailing attendance at their own expense and it came in for particular comment and an expression of appreciation from President Moore. He emphasized that this interest constitutes unqualified assurance of continuing growth of the Association and an ever widening sphere of influence and service to the Tool and Die Industry.

Committee reports and panel subjects were of unusual interest to members, and rightfully so. The former included Business Conduct, Einar J. Johnson, chairman; Fact-Finding, Willis G. Ehrhardt, chairman; Government Relations, W. R. White, Jr., chairman. The first named presented a proposed draft of the "Principles of Business Conduct for Contract Tool and Die Manufacturers". It is reproduced in full elsewhere in this report. A panel discussion of the proposed code had been arranged, with Frank G. Wikstrom, Miles Irmis, Einar Johnson and this reporter as members. However, the code was so well conceived and developed that only brief approving talks by the panel members were required to bring forth a unanimous vote of members for its adoption.

The second general members' session of the convention was presided over by President-elect Willis G. Ehrhardt. There was spirited discussion of two vital Industry subjects: "Developing Specialties in Tool and Die Shops" and "Good Service on Special Tooling."

Taking part in the first named were George M. Jones, J. Kleinoder, Jerome H. Stanek and Guy Hubbard. Argument brought forth that the design and manufacture of special tooling is of itself such a highly developed activity that to do it well constitutes a specialty. However, it was argued that proprietary items do frequently provide activity which fills-in operating valleys and it is logical that their selection be from a family of related items.

An interesting commentary was made by Editor Hubbard (Steel) that the prodigal war days being over it is now the obligation of tooling manufacturers to conserve materials. In the case of metal he advised "pushing it around," not chipping it wastefully.

Two groups, (1) buyers of tooling and (2) manufacturers of it, delivered themselves of opinions which developed into a lively discussion on what constitutes good tooling service. No punches were pulled and this reporter feels safe in stating that when Editor Burnham Finney's (American Machinist) gavel closed the session, Bert Hall, R. W. Updike and Robert C. Eisenmann for the customers, had given the assembled tooling manufacturers some very pertinent points on good service from the users' angle. No less, Frank W. Denning, Joseph N. Huser and Richard F. Moore presented, for thoughtful consideration of such special tooling buyers, the advantages of closer cooperation on designs and specifications.

WILLIS G. EHRHARDT
President-elect, NTDMA
Managing Partner, Ehrhardt Tool & Machine Company, St. Louis, Missouri.

Throughout the committee meetings, the panel discussions and the general sessions, it was evident that the Contract Tool and Die Industry has won its recognition by work well done. It was emphasized that closer cooperation between Contract Tool and Die Shops and production manufacturers requiring such tooling will result in better tooling manufactured at lower cost. When it is realized that the true measure of a tool or die or gage or fixture or a special

machine is not its original dollar cost, but rather the service it renders as denominated by length of life or total number of pieces processed or its period of sustained accuracy, or all of them, then the dollars and cents paid for a tool or an entire program will not occupy the thought of the buyer and user so frequently to the exclusion of these other important evaluating factors.

The Contract Tool and Die Industry came through the war with a high record of service to the Army and the Navy and their contractors whose wheels frequently would not have turned even when they did, if the "impossible" by one or more tooling manufacturers had not been accomplished.

Like all industries, these manufacturers of special tooling will undoubtedly have their ups and downs, but the Contract Tool and Die shop has established its worth and from here it looks as though a period of sustained prosperity for this industry lies ahead.

Two luncheons and the official dinner provided change and relaxation from Association business. Thursday noon, Dr. Harrison S. Brown, on the staff of the University of Chicago and during the war an important Physicist with the Manhattan Project, spoke on the "Realities of Atomic Energy". George S. Eaton, Association secretary acting as chairman at this luncheon meeting, introduced Dr. Brown, whose description of atomic energy, what must be done to control it and what can result if we don't, made a very graphic impression upon his listeners. His forceful comment, that we must control the evils of atomic energy or we will never realize its good, calls for profound consideration.

W. R. WHITE, JR.
Vice President-elect, NTDMA
President, Chicago Tool & Die Institute.
Member Small Business Advisory Committee, U.S. Department of Commerce.
Vice President, Midwestern Tool Company, Chicago, Illinois.

The second luncheon had been arranged jointly with the Chicago Tool and Die Institute under the direction of Stuart A. Sinclair, committee chairman. W. R. White, Jr., President of the Institute, presided and introduced Senator C. Wayland Brooks of Illinois, whose topic might well have been "To What Extent Did Our Participation in the War Advance Representative Government—Or Did It?" After he had conducted his audience through Europe as it exists today, the conclusion which had to be drawn from his address was that even with the army and the navy we built, the lives we sacrificed and the billions of dollars we spent, there is little evidence that the cause of representative government has been strengthened in any part of the work and here at home it has been very considerably weakened. We have work to do if we would preserve our American tradition and we have no time to lose.

Excerpts from Secretary Eaton's address and annual report:

"Certainly we Americans have just about everything worthwhile at stake. It's a bit startling to reflect that when our forefathers reached this country, according to historians, they found this great land supporting not more than a half million Indians who were scattered from border to border. And the natives found it a hard life, indeed, to rely upon game and their crude agriculture to feed and clothe them.

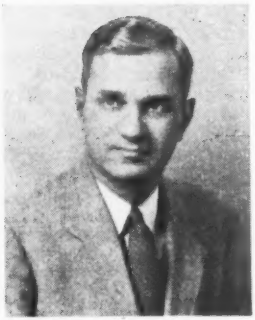
Yet in not more than ten generations our people have spread over half a continent and have developed a machine civilization that supports more than 140 million people in the greatest luxury,

Modern Facilities—
FOR SALE
In every part of the United States are to be found TDM shops with the most modern facilities. According to the requirements of the industrial areas in which they are situated or from which they draw their business, they have carefully planned facilities for the building of
• Tools, Gages, Jigs and Fixtures for all kinds of production
• Dies and Moulds of every description,
• Machines especially designed and developed to increase production and lower costs for almost all industries
• Precision Parts for assembly into products of great accuracy
Hundreds of TDM shops manufacture Stampings and Assemblies, others have departments which specialize in Machine Work. There are large shops and small ones, shops with facilities for building the largest Dies and Machines and also those in which the highly skilled workers seldom work without their gage blocks.
Among the several thousand shops of the TDM Industry is to be found every necessary modern facility for accurately designing and building every conceivable type of special equipment for modern high production manufacture.
Use these modern facilities of the TDM Industry more
Skill . . . FOR SALE
The member shops of the SPECIAL TOOL, DIE & MACHINE SHOP INDUSTRY are becoming ever more important to other industries. Literally, they have "Skill For Sale." Their activities are greatly varied, their products and services many, but SKILL is a preeminent requirement. For every job, workers must possess a high degree of skill. For every job, management contributes the experience which comes only from actual contact with many industries' problems. Together they assure users of the many kinds of custom-built Tools, Dies, Jigs, Fixtures, Moulds, Gages, Machines and other Precision Specialties and Products manufactured in the TDM Shops of the Nation, a degree of service which is well-nigh invaluable. To members of the production industries, we say: Always call in members of the TDM Industry when you have a tooling problem. Their experience, the skill of their workers, the facilities of their shops cannot help but be highly beneficial to you.
They Can't Be . . .
BUILT OVERNIGHT
In designing, developing and building Special Tools, Dies, Machines and the many other precision specialties produced by TDM Industry Shops, the "short-cut" and the "speed-up" have little or no meaning.
New equipment and better methods have reduced the hours required for some operations but Tool and Die Making still are long on head and hand work. Their production can't be stepped up like a machine's.
Some Tool-Die-Machine builders are having a breathing spell. Now is the time therefore for production manufacturers to avail themselves of their facilities. Engineers, designers and all skilled men can now work under less pressure with all-around good results.
Now is the time to call in Contract Tool, Die and Machine Builders for estimates on equipment which will be needed later. Don't wait until all shops are "loaded to the gunnels" again, when everyone will want everything overnight. It just can't be done.
Experience . . . FOR SALE
Experience can't be taught—it is knowledge derived from one's own effort—it is strictly an individual matter.
Experience enables one to instinctively know the right and the wrong of a design, a method or a process.
Experience is invaluable—not alone to him to whom it belongs, but likewise to all others for whom its application may quickly solve a troublesome problem or provide a better method.
The invaluable experience which every CONTRACT TOOL, DIE AND MACHINE BUILDER has acquired in designing and building tools for the production industries is often the most important element of his expert service.
It is available to every Special Tool Die-Machine user. Always call in Members of the TDM Industry to help in solving your production problems.

Almost ten years ago these advertisements commending the Designers and Manufacturers of Special Tooling to the Nation's production industries appeared in the TOOL & DIE JOURNAL.

They mark the beginning of our first efforts to bring recognition to this Industry whose members had, and today have in greater measure than ever, the experience, skill and facilities which enabled them to design, develop and build the tools of mass production.

Tool & Die Industry achievements in manufacturing war products' tools and precision parts were notably outstanding. Again they are ready to move into the vanguard of making tooling for production and inspection according to our new-old formulas for Quality Control.



GEORGE S. EATON
Executive Secretary, NTDMA

when compared with the hardships of only 100 years ago.

Mass production is, of course, the secret of this tremendous advance. And what made mass production possible? Many things, no doubt. But the fact remains that a modern plant may have the finest machinery, ample materials, plenty of labor, able management, and all the money it needs. Yet it cannot turn a wheel until your dies, your molds, your special tools get there. Special tooling *is* the keystone of mass production. . . .

There has been fine cooperation from every corner of the country in making the Nation the strong force that it has become. Building from 75 members to nearly 500 in three short years stands as a real achievement. And it is well that the NTDMA has become strong. This is the day of organization such as our country has never known before. Labor has grown in power beyond its wisdom. Unions listen only to the heavy tread of force. The government has tremendous armies of employees to check up on what you do and what you don't do. It has planning staffs to think up new ways to harass you.

Then the manufacturers who are your customers are all thoroughly organized in their own trade association. The purchasing agents are organized in their own associations. Even the consumers are becoming organized.

Such minor industries as the bobbin manufacturers, the makers of artificial flowers and feathers, the auger bit manufacturers, and the blotting paper manufacturers have had their own trade associations since the middle 30's.

Organization in no way means giving up your individuality or hampering the conduct of your business. But it does open possibilities for cooperative activity in defense of your rights and in the expansion of your business. It makes it possible to learn what is actually going on in the industry—to stamp out unfair and foolish practices—to avoid labor piracy—to get tax relief—to keep wage rates at reasonable levels, neither too high nor too low—to broaden markets for special tooling—to gain recognition for the vital role played by the Contract Tool and Die Industry in American life.

What this country must do to continue its long rise in the standard of living for the common man is to produce more. The belief that men can do less work and get more pay for doing it, produce less and have more, has destroyed nations. The plain fact is that if the entire shares of the owners and management were split up among all workers, each one of them would get less than 10% above what he now gets. And such starving of the owners and management would destroy the jobs themselves.

Fortunately the pay check is not all that men work for. There are satisfactions that come from doing an interesting job well. And opportunities for gaining such satisfactions are especially to be found in tool and die shop work. "A man needs to be needed." Recognition of a man's desire to do good work and a word of praise when he does well often work wonders. This is just one of the many points that require continual attention if relations with your employees are to be what you want them to be. And make sure that there are no unsettled grievances to fester and lead to serious trouble.

It is splendid that so many of you found time to attend our first Annual Meeting. Next year make it a point to bring another shop owner with you. It's hard for a busy man to get away, I know. But ants, the busiest of all, still are always willing to take the time to go to all picnics. We can surely find

time for a few meetings. There are still going to be a number of matters at Washington that will be of direct interest to you. Aside from Selective Service, OPA, and CPA priorities, all of which are fast diminishing in importance, there remain apprenticeship training and the matter of limitations on the maximum federal payments to veterans; the reopening of the opportunity to get certificates of necessity or the granting of accelerated depreciation; getting tax relief for small businessmen; establishment of plans for the financing of small businesses; and the whole field of labor relations."

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Hydraulic Valves And Control Devices Part I

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★ *Editor's note: The Cleveland Engineering Society recently held a Machine Design Conference on "Hydraulics". Through the courtesy and cooperation of the Society, Mr. E. C. Hartly, Chairman, Machine Design Division, and the authors of the several conference papers, TOOL & DIE JOURNAL is able to present the latest trends and applications of hydraulics know-how. In addition to Mr. Schuette's paper, other subjects by equally prominent authorities include: "Advantages and Limitations of Hydraulic Applications in Machine Design," "Hydraulic Pumps and Power Units," "Trends in Hydraulic Applications in Machine Design," "Hydraulic Oils," "Hydraulic Circuits and Calculations" and "Hydraulic Applications from the User's Viewpoint."* ★

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The terms "controls" and "valves" are oftentimes used synonymously.

For the sake of this discussion we will define a "valve" as a device or means for regulating the flow of fluid. Included in this category will be all types of pilot valves, directional valves, metering valves, 4-way valves and devices of a similar nature.

A "control" we will define as a mechanism which exercises direction, guidance or restraint over the transmission of power by a hydraulic mechanism. Typical examples are: the shifting mechanism on a variable displacement pump or hydraulic motor, and devices which may be included in the general category of a servo mechanism.

Most Common Uses

Valves are most commonly used in what we in hydraulics speak of as an open circuit system. This is a system wherein the prime mover consists of a constant displacement hydraulic pump driven by an electric motor and a cylinder or hydraulic motor which is intended to do the desired work at the speed, or in the direction, desired. The valves which are, therefore, placed between this prime mover or pump and the cylinder or motor take on many forms that give the desired characteristics. A simple typical circuit may consist of a constant displacement pump, a relief valve, a directional valve, and a cylinder or hydraulic motor. When applied to a machine this circuit provides for the conversion and direction of the capacity of the pump to either linear or rotational motion. At the command of the direc-

by L. H. Schuette
Chief Production Engineer
Sundstrand Machine Tool Company
Pump Division, Rockford, Illinois

tional valve, the cylinder or hydraulic motor moves in either direction at a rate determined by the pump capacity. This directional valve can take on many forms, but for the sake of our discussion we will call it a 4-way valve. This valve is a very simple device consisting of a cylindrical stem with a number of grooves, so located in a housing containing machined or cored ports that when moved to various indexed positions it directs the flow of oil from the pressure source to either end of the cylinder and provides for the return of the oil from the cylinder to the tank. The stem may be shifted by a manual lever, by a solenoid directly attached to it, or by pressure supplied to either end by a pilot valve.

The two latter methods provide for automatic operation by having the solenoid or pilot valve actuated by a cam, by dogs on the table of the machine, or by a series of electric switches intended to operate in sequence by timers and similar devices.

Design Variations

By proper design variations of the arrangement of the ports and the number of lands on the stem, a large number of functional characteristics can be obtained.

With a closed center 4-way valve, we can obtain the effect of suddenly stopping the cylinder. With manual control or with solenoid control, we can obtain the effect of "inching" or "jogging". We can obtain some control over the rates of acceleration and deceleration so that a load can be brought up to speed smoothly and can be decelerated smoothly. If the entire valve is mounted on a moving assembly, such as the table of a machine, this same valve can give servo control. The slightest movement of the controlling lever can be duplicated or amplified at the cylinder.

Operating Requirements

The important considerations to be given these valves when applying them to a circuit are (1) the valve must have sufficient area of opening to permit the flow of oil without an appreciable pressure drop, (2) it should provide the proper control cycle desired, (3) it should, in the case of the manually operated valve, be hydraulically balanced so that a minimum of effort is required for shifting (and in the case of an automatically actuated valve, be designed so that pressure binding of the stem will not take place) and (4) the materials from which it is to be made should be such that long life and reliable operation will be assured.

Because of the rapid rate at which this stem can be moved to transfer the pressure from one side of the cylinder to the other, some caution should be exercised in the application of pilot or solenoid operated 4-way valves. We will assume for a moment a heavy table moving with a reasonable velocity and at a certain point in this movement we will actuate a switch which energizes the solenoid and immediately pulls the stem to the opposite position. This will call for immediate reversal. When this transfer takes place the maximum pressure of the system is applied to deceleration and acceleration. In certain cases this sudden shock is of sufficient magnitude to cause damage to the work, the cutters, or to the machine itself.

Control by Metering

In the case of a solenoid operated 4-way valve, its rate of operation is fixed by the pull characteristics of the solenoid. However, in the case of a pilot operated valve, a metering orifice can be installed in the pressure source for actuating the stem, thus giving some control over the rate of shifting and, in turn, some control over the rate of deceleration and acceleration of the load moved by the cylinder.

For manual valves it is possible to cut metering grooves in the lands of the stem and thus obtain additional control over the rate of reversal.

For manually operated valves, this rate of reversal is, of course, controlled by human effort. In the case of solenoid valves this rate of reversal can be as high as 75 to 150 cycles per minute. These characteristics are, of course, a natural result of the design of the solenoid and are governed entirely by the ability of the magnetic field to build up and provide the pull characteristics.

In the case of pilot operated 4-way valves, we are able to get even greater rates of reversal.

When the 4-way valve of our typical circuit is shifted and the cylinder begins to move, the pressure in the circuit will rise to a value necessary to do the work intended at the end of the pistion. Since the amount of work to be done is always taken into consideration when engineering the application, this pressure would be within the rating of the pump and the cylinder. Should the piston be restricted in its movement, or should the cylinder hit at the end of its stroke, the pressure would rise to an infinite value providing there is no valve in the system to limit this maximum pressure. Such a valve is commonly called a relief valve.

For our typical circuit described above, a relief valve is only a safety measure; however, in other applications which will be discussed later, it must not only perform the function of a safety valve, but it must regulate the pressure in the supply system to some reasonably accurate pre-set value so that the desired characteristics of operation can be obtained. This valve is, therefore, made usually in two basic types: (1) a safety relief valve, and (2) a pressure regulating relief valve.

The first type consists merely of a plunger or a valve stem, a housing with a seat for the plunger, and a spring with provisions for its adjustment. When pressure is applied to the plunger, the spring is compressed, opening the valve seat and by-passing the oil to the tank. When the pressure of the system is considerably below the setting of the valve, sufficient seal is present to prevent leakage. However, if the pressure rises, the stem must move against the spring towards its by-pass position, thus decreasing the length or effectiveness of the seal. As the seal is decreased, considerable leakage begins to take place and this leakage is in reality a loss in power available to do the work intended. If the pressure is increased further, the valve clears its seat, by-passing the excess oil.

If the valve is required to by-pass the total capacity of the pump, as in our circuit when the cylinder is "dead ended", the valve must open wider thus compressing the spring further, permitting an additional increase in pressure. This, at times, can be considerably in excess of the valve setting.

While this type of valve has poor pressure regulating qualities, it can be made relatively inexpensive and will be satisfactory when used merely as a safety means to prevent the pressure from reaching a value which may be injurious to the remainder of the mechanism.

Pressure Regulating Valve

The second form of this relief valve, which we previously referred to as a pressure regulating relief valve, is more expensive, but the undesirable characteristics outlined above are reduced to a minimum. It consists of a stem or plunger; a housing containing ports, the plunger bore, and the valve seat; and a pilot or servo valve. This pilot or servo valve takes a pressure signal from the main pressure source and regulates the pressure actuating the opening and closing of the valve on its seat within the relatively narrow limits which are possible to obtain at the pilot or servo valve. Even after the pressure setting has been reached, further increases in by-pass flow, such as when the cylinder is "dead ended" does not cause an appreciable increase in pressure. It is, therefore, the most desirable type of valve to use when systems are being designed around an intended pressure.

Combination Valve

Included in this general category we should mention a third type of valve mechanism. If the desired movement of the piston is fixed by the overall design and its operation is reasonably intermittent, an accumulator-unloader valve combination may be used to advantage. This permits the use of a much smaller pump which supplies oil to an accumulator. When the accumulator is filled to the desired pressure, it operates a valve which dumps the pump capacity to the tank at very low pressure, thus decreasing to a minimum the power input. When the cylinder is operated by a 4-way valve, the work is performed with oil supplied from the accumulator. When

the pressure in the accumulator drops, it reverses the action of the unloader valve, permitting the accumulator to again be filled by the pump.

While this combination is a relief valve, it is usually desirable to provide a secondary safety type relief as first described.

As previously stated, this system should only be used where definitely controlled movements are prescribed by the design of the machine. If large capacities are necessary, then, of course, the size of the accumulator will be entirely out of proportion to the size of the remainder of the equipment making up the system.

Metering Valve

In all of the above cases we have assumed that the cylinder would move at a rate determined by the capacity of the pump, but often it is desirable to have some control over this rate independent of the capacity of the pump. To permit this, it is necessary to install a metering valve to regulate the flow of oil to the cylinder. The metering valve is essentially a manually adjustable orifice in combination with a pressure reducing valve for regulating the pressure across this orifice. The pressure reducing valve is internally connected to the pressure supply and to the meter supply port.

Temperature Control

When using this means for obtaining a variable rate of movement on the operating cylinder, a pump having a capacity sufficient to deliver the maximum amount of oil must be selected. At all rates of cylinder movement below that obtained from this maximum, the excess oil must be by-passed over a relief valve. This means excessive power input for the amount of work being done. When the valve is used, care must be exercised to control the system temperature since the amount of oil permitted through the metering orifice is dependent both on pressure and viscosity of the oil. A change in temperature will cause a change in the amount of oil. Some attempts have been made at compensating for temperature, but these have been only reasonably successful. The difficulty is that the temperature compensation must match the viscosity index of the oil. If the oil supply is changed and a slightly different viscosity index results, then, of course, the compensating means will over—or under—compensate, whichever the case may be.

Multi-cylinder Circuits

In many cases, it is desirable to operate more than one cylinder from a common source of supply. For this type of a circuit we will again use the constant displacement pump and a pressure regulating type of relief valve. To this source of pressure we will connect a number of cylinders and interposed between them will be 4-way valves. By controlling the 4-way valves, either remotely or manually, the cylinders will operate in sequence, as dictated by, for example, the setting of dogs on the table of the milling machine.

When applying this circuit it should be remembered that each cylinder will operate at a rate determined by the maximum capacity of the pump unless devices, such as a metering valve or a restricting orifice, are installed in the line to give some control over the operating rate of the cylinder. This has some importance, particularly when a number of cylinders of different sizes, to do definite amounts of work, are to be operated from one common source of supply. In a case where a number of cylinders are to be operated in a definite sequence, it is possible to use a hydraulic valve, commonly known as a sequence valve. The sequence valve can be either a pilot operated pressure relief valve, previously described, or it can be a valve arranged so that when one cylinder reaches its desired position and "dead ends", the pressure in the circuit will rise and this valve will transfer the flow of oil to a second or third or fourth cylinder. Some caution should be used in the application of this type of valve since it is extremely sensitive to the differential pressure required by each cylinder of the overall system.

Filter Requirements

When applying all these valves individually, we naturally recommend that

(CONTINUED ON PAGE 158)

Inventory Procedures For Tool Steel

by Benjamin Melnitsky

The sole similarity between regular bar stock and a bar of tool steel is nomenclature, i.e., both are bars. Otherwise they bear the same relationship as a watchcase does to a suitcase. It would be highly illogical to use the same inventory method for the two "cases" simply because they have similar designations. It is just as illogical to use identical inventory methods for bar stock and tool steel. Yet, in many plants inventory crews proceed blithely from carbon steel, to alloy steel, to tool steel using precisely the same inventory methods for all three.

The absurdity of this situation is especially apparent when consideration is given to the unique features of tool steel. Aside from the fact that it is used for different purposes, tool steel is much more expensive than regular bar stock. A discrepancy of several hundred pounds in an inventory for low-carbon steel means but a few dollars; whereas the same discrepancy for tool steel represents several hundred dollars.

Inventory of tool steel requires special knowledge and background that ordinary inventory personnel do not possess. Only a trained and experienced person can know the complexities of tool steel; he alone is qualified to differentiate among different types, grades, and brands.

Demand for tool steel is far in excess of supply and sources of supply are often distant; consequently ordering periods are longer. This means that purchase requisitions and orders to vendors must be placed far in advance of plant requirements so that sufficient time will

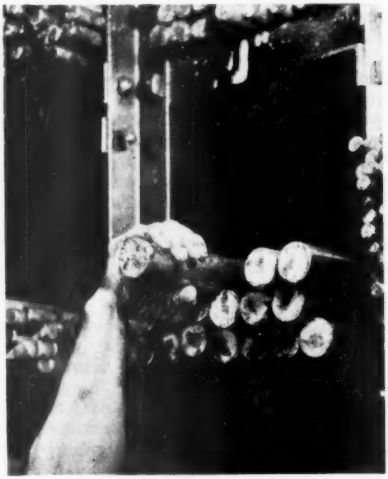

Fig. 2. Rack storage of bars in Betz-Pierce warehouse. Accurate inventorying plus good housekeeping facilitate handling of tool steel stocks. Photo courtesy Republic Steel Corporation.

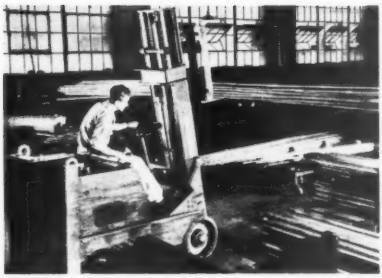

Fig. 3. Stock 18 feet in length is awkward and heavy to handle. At the Warner Gear Division plant of the Borg-Warner Corporation, one of their eleven Towmotors takes over and effects economies of time and effort during large-scale inventory operations. Photo courtesy The Towmotor Corporation.

be allowed for delivery. This is possible only if tool steel records are extremely accurate. Records can be accurate only when they are based on correct inventory figures. An error on records for regular bar stock can be covered up by using alternate types of bar stock or by using over-size bars. A 1½" diameter bar of C 1020 can be turned down to 1¼" diameter when the latter size is unavailable. The prohibitive cost of waste metal would preclude this procedure in the case of tool steel.

The need for accurate records, the need for trained personnel, the need for extremely accurate and precise inventory figures, all indicate the need of special techniques in tool steel inventories.

Inventory Personnel

Knowledge of tool steel is the first prerequisite for supervisory inventory personnel, but this requirement should not be extended to materials handlers. A man can do an excellent job of pulling a bar from the rack, placing it on the scale and then replacing the bar, all

TOOL STEEL INVENTORY

DATE 10/23/46 SHEET NO. 2 OF 6

SIZE AND TYPE	COLOR ON BARS	STAMP MARKS	CHECKED BY	NUMBER OF BARS	CHECKED BY	GROSS WEIGHT	TARE WEIGHT	NET WEIGHT	HANDLED	CHECKER	KEY NO.
¼" dia Stentor	gray	STEN	Ew	25	RP	115#	15#	100#	PK RF	WR	1
⅜" dia Stentor	gray	STEN	Ew	10	RP	40#	15#	25#	PK RF	WR	2
½" dia Stentor	gray	STEN	Ew	100	RP	970#	15#	955#	PK RF	WR	3

Fig. 1. An inventory sheet designed for tool steel. To insure correct identity of inventoried bars, both color and stamp marks appearing on bars are recorded on the sheet. To eliminate the possibility of including weight of tare, three columns are used for posting weight of stock. The first column, gross weight, is posted directly from the scale reading. The second column, tare weight, is the weight of the cradle or frame placed on the side for holding the bars. The net weight in the third column is obtained by subtracting weight of tare from gross. The initials of the materials handlers and checkers are posted in the tenth and eleventh columns.

without knowing the first thing about tool steel. He needs nothing more than a strong back and the specialized knowledge of how to handle bars of steel. Therefore, the inventory personnel should be divided into two distinct categories: (1) supervisors who know tool steels, and (2) laborers trained not in tool steel but in materials handling.

Accuracy is synonymous with system and system means procedure. All inventory phases should be formalized and organized into a printed procedure form so that each participant will understand his precise duties and each action during the inventory will fit in with the general, predetermined scheme of things. The need for procedure is present during all inventories; however, the need is more acute during the tool steel inventory because the stakes are higher.

Briefly stated, the printed inventory procedure form should embody the following factors:

(1) *Authority and responsibility* should be indicated on an organization or flow chart. Such a chart will do much to eliminate overlapping of authority and will serve to unify the entire inventory effort.

(2) *Precise inventory methods* should be employed. The usual methods for inventorying bars are: (a) measuring, (b) estimating, and (c) weighing. Since the weighed inventory has the advantage of being extremely accurate, it should be used for tool steels. However, there are many pitfalls to be encountered in this type of inventory. They can be overcome only if correct procedures are adapted which will anticipate and correct the inherent shortcomings of the weighed inventory. Such procedures should embody the following factors:

(a) To insure that every bar is identified correctly, a thorough check should be made of color on ends of bars; stamp marks along length of bars; and of all other identifying labels, tags, or marks. This should be done for every bar that is inventoried so that if the inventory sheet lists 150 pounds of 1¼" diameter Stentor, it will be known that every pound is actually the type indicated.

(b) The next factor to be considered is size. If the 150 pounds of 1¼" diameter Stentor are actually made up of 100 pounds of 1¼" and 50 pounds of 1⅛", little has been gained by insuring correct identity of the material. To guarantee that the right size is being inventoried, every bar that is weighed should be checked for size. The most accurate means of checking size is to measure the first bar of a lot with a micrometer. A caliper is then set on this measured bar and all other bars in the lot checked with the caliper. This is an accurate and quick method of insuring correct size. It is always wrong to assume that every bar in a lot of steel is the same size; each individual bar should be calipered. The size of the bars should be double-checked on the scale.

(c) The scale itself is often a source of error in the weighed inventory. It goes without saying that the scale should be oiled, repaired, and checked for accuracy prior to the inventory. In addition the scale should be checked frequently during the inventory. A heavy load or a bad jolt will often result in a wrong reading. Every hour or after every heavy load, all weights should be removed from the scale and the scale checked at zero reading. If necessary, the scale should be adjusted on the spot by some qualified person. Transcription of weights from scale to inventory sheets is often done incorrectly. Such errors can be eliminated if each scale reading is double-checked.

(3) *The paper work* is equally as important as the procedures to be followed in weighing tool steel. The printed inventory procedure should include each item of paper work used during the inventory together with a detailed presentation of exact methods to be followed in posting the paper work. One of the most important of all inventory forms is the sheet used in transcribing inventory figures. Extreme care should be used in the design and posting of this particular form. See Figure 1.

An important problem during the inventory and at all other times is the question of what can be done with short ends of bars. If they are discarded, a good deal of material is lost. On the other hand, if they are saved, the tool steel storeroom gets cluttered up with these bits and short lengths. They are often overlooked during the inventory

and not included on card balances; if they are used after the inventory, the weight represented by these pieces will be deducted from stock balances thereby distorting the record. Supposing that great pains are taken to inventory this material and results are still not good. That such would be the case can be seen from the following example: all 1" diameter Rex A.A.A. is inventoried and the inventory figure is 200 pounds. Of this total weight, 50 pounds are made up of short ends. If the 200 pounds are posted on the stock card for this material, those who requisition from the card will assume that the 200 pounds represents usable stock and this would be a false assumption because the short ends could not be used for most jobs.

The most satisfactory solution for this problem is to remove all short pieces from the regular rack and to deduct their weight from the different card balances. This does not mean that these pieces should be discarded, because in many instances they can be utilized in the fabrication of small parts. Instead, the short ends are placed in a special rack and considered as scrap material to be used without paper work. Removing these pieces from the racks is a simple task, whereas removing them from the records is a little more difficult. Ordinarily the pieces would have to be segregated by size and type and their weight deducted from each stock card. However, this same job can be done during the inventory without any trouble at all.

Before the inventory is taken, all short ends are collected and set aside. They are not inventoried and the loss on stock records represented by these pieces is considered as an inventory loss. Thus, the problem can be solved without paper work or red tape.

After the inventory is taken, the accumulation of short ends in the regular rack and on records can be eliminated by charging the weight of short pieces to jobs that cause them. Thus, if a job requires 10′ 0″ from a 10′ 6″ bar, the total weight of the bar is charged to the job and the unused portion is placed in the special rack. When the short piece is used, its weight is not deducted from the card balances.

In addition to instituting a program for charging off short ends of tool steel bars, the inventory should also serve several other functions. Inventory period is an excellent time to institute new systems and to improve the appearance and condition of the tool steel storeroom. This is possible because, during inventory, bars are taken from the rack and moved about. This handling process can be used in bringing about the following improvements in tool steel control:

1. Ends of bars should be painted with identifying colors. Both ends of the bar should be identified in this manner.

2. Bars that are not stamped properly should be stamped.

3. Stock should be arranged according to size and type. For example, if 1" diameter Stentor was kept in three different sections of the rack, it should be consolidated into one rack when it is taken off the scale.

4. If new racks are to be used or stock is to be shifted, the best time to do so is during inventory when materials are being moved in and out of racks.

5. All improvements and modifications in storeroom procedures and techniques which entail material movement should be made part of the inventory material movement program.

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EDITOR'S BLUEPRINT FOR DECEMBER

Press Tool Applications of Casting Resins — ***the increasing use of synthetic casting resins for stretch press and hydropress dies and for drill jigs, assembly jigs and holding fixtures.***

TOOLING EXPEDIENTS:

A Simple Punch and Die Made from Hex. Socket Wrench and Screw

Indicator Button Setup for Milling-Fixture Alignment

CONTINUING FEATURES:

A Tooling Program for Forged Globe Valves

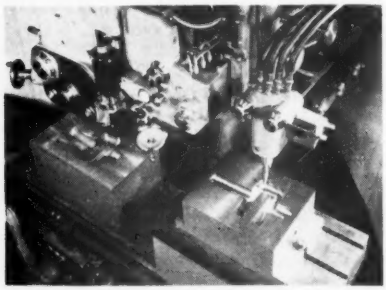
The Broaching of Brasses and Bronzes

Hydraulic Valves and Control Devices

One Machine Mills Die-Sinks and Profiles

The latest addition to the Cincinnati Hydro-Tel line, the 16" Vertical, is extremely versatile as a general purpose milling machine. The type of construction and hydraulic actuation of all movements of this machine, built by The Cincinnati Milling Machine Co., make it an unusually flexible unit for many potential uses. As a consequence, it is built in three distinct styles: a General Purpose Milling Machine, a Die-Sinking Machine with Automatic Depth Control, and an Automatic 360° Profiling Machine. All styles of the machine are equipped to exclude chips and dirt from the table and cross-slide bearings, and to simplify the accurate leveling of the machine.

The General Purpose Machine is the basic machine, provided with hand and power feeds to the table and cross-slide; hand feed only to the vertical spindle carrier. It is excellent for hand controlled die-sinking and general purpose operations. Effortless operation; smooth, cushioned cutting action; and instant selection of the exact feed rate desired, are provided. Wide spaced bearing ways for all sliding units provide additional rigidity for accurate, vibration-free performance and heavy cutting capacity. Positioning of the slides to definite locations is extremely accurate. Large parts may be conveniently loaded by swiveling the adjustable brackets below table level. The Turret Stop and Dual Indicator attachment greatly speeds the production of parts involving accurate cuts at differing depths. Used in conjunction with the power vertical feed, it serves the dual purpose of automatically disengaging the power vertical feed at any preselected depth, and providing a visible indication of accurate vertical hand adjustment. The Vertical Power Feed attachment supplies feed rates ideally suited to boring operations; and infinitely variable over their complete range, allowing operator to set exact feed rate desired. An alternate speed range, available from the spindle drive motor, is excellent for milling aluminum and other soft materials. The built-in quick change spindle nose permits changing of cutters, and the use of standard cutters, or quick change arbors and adaptors with minimum amount of change-over time. A pressure switch assures positive action of the pressure lubricating system, if the lubricating pressure should fail for any reason; thus protecting the ways against accidental scoring. The switch stops all motors.

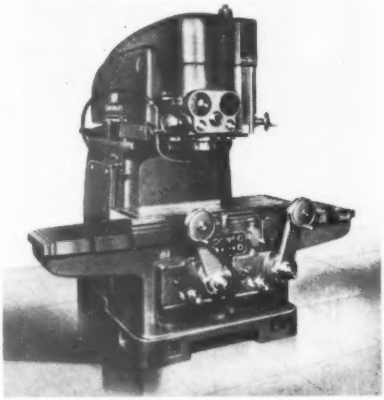


Addition of the Automatic Depth Control mechanism transforms the machine into an unusually efficient and accurate die-sinker, as illustrated at the left. It is capable of automatic, accurate duplication of profile templates, master shapes or existing dies. This mechanism consists of a completely automatic hydraulic tracer for synchronizing the vertical

movements of the spindle carrier with table and cross-slide movements to simplify the production of dies or other intricate shapes. Master shapes may be accurately duplicated, or, if form remains constant along one axis, templates may be used. Template support brackets supplied for table and cross-slide movements greatly simplify setups where templates are used to obtain the desired shapes. Master shapes of wood, plaster of paris, or any of the various pattern compounds may be used to good effect since the tracer finger contact pressure is very light. The tracer mechanism, carried on three sliding members, provides longitudinal, transverse, and vertical adjustment of the tracer finger relative to the cutter spindle. Each adjustment is provided with a micrometer dial to simplify accurate positioning when setting up. Sensitivity of the tracer is ample to permit use of power feeds to the table or cross-slide, even when tracing comparatively steep angles. Power feed rates may be employed for tracing various angular surfaces while still retaining reasonable accuracy of duplication; higher feeds may be used when this degree of accuracy is not required. Normally, the tracer mechanism automatically disengages itself when the tracer finger is hanging freely, not in contact with a guiding surface. This is an important safety feature and prevents damage in case the tracer finger should accidentally leave the guiding template. A selector valve in the tracer mechanism permits automatic disengagement of the tracer to be bypassed if desired. This can be used on jobs requiring repeated tracer controlled cuts up a sloping surface. The Automatic Feed Cycle, supplied for machines equipped with the Automatic Depth Control, makes the machine a completely automatic die-sinker. It provides an automatic, dog-controlled cycle of cross-feed movements with automatic, adjustable pickfeed of the table at each reversal of the cross-slide. The feed rate is automatically reduced when tracing surfaces of increasing steepness, and increases as steep angles of rise give way to lesser angles . . . an important feature. The table template bracket provides a simple, convenient means of mounting a sheet metal profile template parallel to the direction of table movement.

A Rotary Vise attachment is available for convenience in positioning the die-block when the machine is used for die-sinking complex die cavities.

When the Automatic 360° Profiling Tracer Mechanism is supplied, all movements of table and cross-slide are controlled solely by the tracer mechanism; table and cross-slide hand or power feeds are not supplied. The mechanism duplicates profile shapes in a horizontal plane.



The cutter will follow the same path around the workpiece that the tracer follows around the master template, thereby accurately reproducing the contour of the template on the workpiece. Direction of tracing around template may be in either direction, permitting cuts to be taken by either the conventional or "climb" methods of milling.

With this summary of the unusual features and capabilities, it can be seen that this machine, shown above in basic state, is an important contribution to the field of milling die-sinking.

More complete information on these machines is contained in a 20-page, fully illustrated catalog, which may be obtained by writing for Publication No. M-1497, to The Cincinnati Milling Machine Co., Dept. 2-33, Cincinnati 9, Ohio, or use our postage-free INFORM-A-GRAM Key No. 233-R.

SIMPLY INSERT OPTI-SETTER in drill jig, align cross lines to work layout, clamp drill jig, remove OPTI-SETTER, and drill!

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MANUFACTURERS OF OPTI-TOOLS

(CONTINUED FROM PAGE 94)

times a day. This was the standard of measurement for the room, and the operators used conventional micrometers. By the new procedure each operator made his own master, checked it himself under the sensitive standard comparator, and thereafter set his own indicating gage to that master.

The psychology introduced is self-evident. Previously, all final measurements had been made by inspectors. The new arrangement put the responsibility for dimensional accuracy up to the operator.

The next step consisted of an agreement with the production department to the effect that if the work at any machine reached or exceeded plus .0003", or minus .0003" ("plus-minus .0003" as contrasted to the blueprint tolerance of plus-minus .0005"), the operator would immediately make suitable adjustments at his machine, in much the same manner as he formerly arranged his setup if he found his work at one blueprint tolerance or the other, i.e., plus .0005" or minus .0005".

Although plus-minus .0003", as contrasted to plus-minus .0005", is a deliberate narrowing of manufacturing tolerances, nevertheless, the plus-minus .0003" figure was arrived at by "statistical methods" since plus-minus proved to be 3 sigma limits for the average distribution as shown by Figure 3.

For the final 100% inspection setup, a practical sampling plan was adopted. This consisted of taking a sample of 33 from each batch of 100 finished pieces and checking these. If no defects were found among the 33-piece sample, the entire batch was passed as okay. When one or more defects were discovered, the particular batch was sent for 100% sorting. (The sampling plan is an adaptation from the Dodge-Romig single sampling table for an average outgoing quality (A.O.Q.L.) of 0.75%).

By applying the Quality Control methods explained above, plus "control" steps taken along the production line, the chief inspector found he practically never had a dimensionally inaccurate piece slip through to the buyer. At the same time he was able to reduce his inspection cost by 30 percent, the required figure.

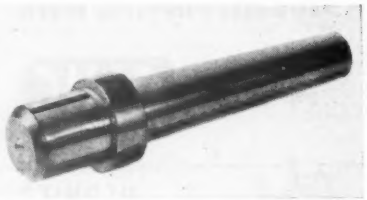
Self-Locking Work Holding Device

Roller clutch precision mandrels, manufactured by the Young Arbor Company, are now available for bore diameters .500" and up. Expanded production facilities now make this increase in obtainable sizes possible. Users' experiences with this self-locking, self-expanding, self-contracting and instant releasing mandrel indicate that the principle incorporated in its design is correct. This is the time-tested over-running clutch principle. By its use, "C" washers, wrenches and draw bars are eliminated in operating the mandrel, and concentricity in the low 10,000ths is maintained for the entire length of the work. Parallelism of sleeve surface to center-line and the absence of variation in repeated mounting of parts is assured. Uniform full-work-length friction-locking gives complete control and contact of entire bore area. No auxiliary power is required to expand this mandrel, and it cannot be sprung or damaged under normal use.

The operation cycle is speeded by its use and precision to close tolerances is maintained. The work is merely slipped on the mandrel with a counter-clockwise motion, locked in place automatically, and then is ready for cutting tool, grinding wheel, deburring or polishing operations.

Cutting pressure merely results in a tighter hold on the work. Work releases as easily as when loading.

Details will be sent by YOUNG ARBOR CO., Dept. 52, 3257 Bradford Rd., Cleveland Heights 18, Ohio, or use INFORM-A-GRAM Key No. B52-R.



Handy

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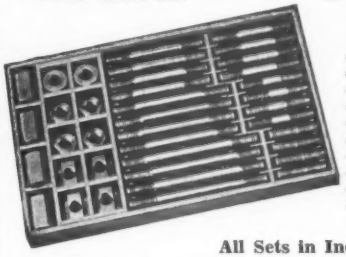

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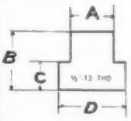
4—5" Studs
4—7" Studs
4—Nuts
4—"T"-Slot Nuts
4—4" Studs
4—6" Studs
4—8" Studs
4—Washers
4—Coupling Nuts

All Sets in Individual Cases

Specially designed T-slot nut will prevent damage to table slots caused by ordinary nuts.



Holes & Thread	A	B	C	D
½"—13 THD.	.555	¾"	11/32"	⅜"
⅝"—11 THD.	.675	1⅛"	15/32"	1⅛"
¾"—10 THD.	.800	1⅜"	½"	1⅜"

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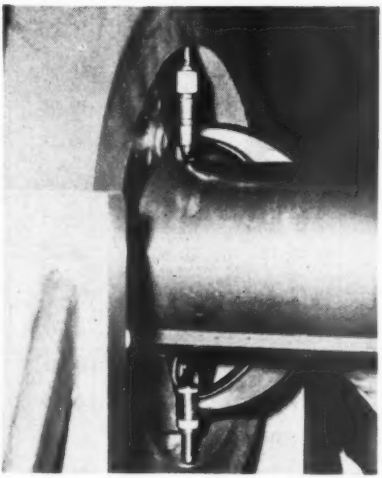
Measuring With Over-the-Bar Tubular Inside Micrometer

Measuring bores without removing the boring bar is possible with the Tubular Over-the-Bar Inside Micrometer that determines bore sizes over or around center obstructions. It is placed around the bar in measuring position and reading is taken, as shown. The device comes in a standard range of sizes, and covers bar diameters from 4″ to 8″. It will fit over a variety of bar sizes.



The hollow-box type construction of this tubular micrometer gives it rigidity plus lightness in weight, a feature accounting for about fifty percent saving in weight over the solid-frame type of the same size. This lightness makes it especially easy to handle.

Direct inquiries to TUBULAR MICROMETER CO., Dept. 91, St. James, Minn., or use our INFORM-A-GRAM Key No. B91-R.

"Take A Look At Mercury"

The Mercury Tool & Die Co., Inc., of 1600 East Nine Mile Road, Detroit 20, Michigan, is offering a new catalog entitled "Take a Look at Mercury" which is designed to give a close-up view of the company's facilities in plant, machines and skills for producing tools, dies, jigs, fixtures, gages and special machinery. For your copy and also a copy of the company's regular publication, "Mercury Wings", write direct or use our postage-free INFORM-A-GRAM Key No. J91-R.

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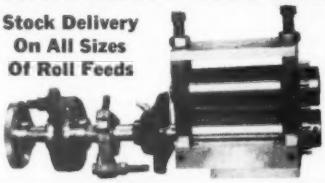

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TDJ SHOP DATA SHEET NO. 53

Approximate Blank Diameters for Drawn Shells (inches)

SHELL DIAM. (inches)	DEPTH OF DRAW (inches)					
	7.000	7.500	8.000	8.500	9.000	9.500
6.250	14.65	15.10	15.50	15.90	16.30	16.65
6.500	15.00	15.45	15.85	16.25	16.65	17.05
6.750	15.35	15.80	16.20	16.60	17.00	17.40
7.000	15.70	16.10	16.55	16.95	17.35	17.75
7.250	16.00	16.45	16.90	17.30	17.75	18.15
7.500	16.35	16.80	17.25	17.65	18.10	18.50
7.750	16.65	17.15	17.60	18.00	18.45	18.85
8.000	17.00	17.45	17.90	18.35	18.80	19.20
8.250	17.30	17.80	18.25	18.70	19.15	19.55
8.500	17.65	18.10	18.60	19.05	19.45	19.90
8.750	18.00	18.45	18.90	19.35	19.80	20.25
9.000	18.25	18.75	19.25	19.70	20.15	20.60
9.250	18.60	19.10	19.55	20.05	20.50	20.95
9.500	18.90	19.40	19.90	20.35	20.80	21.25
9.750	19.20	19.70	20.20	20.70	21.15	21.60
10.000	19.50	20.05	20.50	21.00	21.45	21.95
10.250	19.85	20.35	20.85	21.30	21.80	22.25
10.500	20.15	20.65	21.15	21.65	22.10	22.60
10.750	20.45	20.95	21.45	21.95	22.45	22.90
11.000	20.75	21.25	21.75	22.25	22.75	23.25
11.250	21.05	21.55	22.10	22.60	23.10	23.55
11.500	21.35	21.85	22.40	22.90	23.40	23.90
11.750	21.65	22.14	22.70	23.20	23.70	24.20
12.000	21.95	22.50	23.00	23.55	24.00	24.50

TDJ SHOP DATA SHEET NO. 54

Approximate Blank Diameters for Drawn Shells (inches)

SHELL DIAM. (inches)	DEPTH OF DRAW (inches)				
	10.000	10.500	11.000	11.500	12.000
6.250	17.05	17.40	17.75	18.10	18.45
6.500	17.40	17.80	18.15	18.50	18.90
6.750	17.80	18.15	18.55	18.90	19.25
7.000	18.15	18.55	18.90	19.30	19.65
7.250	18.55	18.90	19.30	19.65	20.05
7.500	18.90	19.30	19.70	20.05	20.40
7.750	19.25	19.65	20.05	20.45	20.80
8.000	19.60	20.00	20.40	20.80	21.20
8.250	20.00	20.40	20.80	21.20	21.60
8.500	20.35	20.75	21.15	21.55	21.95
8.750	20.70	21.10	21.50	21.90	22.30
9.000	21.05	21.45	21.85	22.25	22.65
9.250	21.35	21.80	22.20	22.65	23.00
9.500	21.70	22.15	22.55	23.00	23.40
9.750	22.05	22.50	22.90	23.35	23.75
10.000	22.40	22.85	23.25	23.70	24.10
10.250	22.70	23.15	23.60	24.05	24.45
10.500	23.05	23.50	23.95	24.40	24.80
10.750	23.40	23.85	24.30	24.75	25.15
11.000	23.70	24.15	24.60	25.05	25.50
11.250	24.05	24.50	24.95	25.40	25.85
11.500	24.35	24.85	25.30	25.75	26.20
11.750	24.70	25.15	25.60	26.05	26.50
12.000	25.00	25.50	25.95	26.40	26.85

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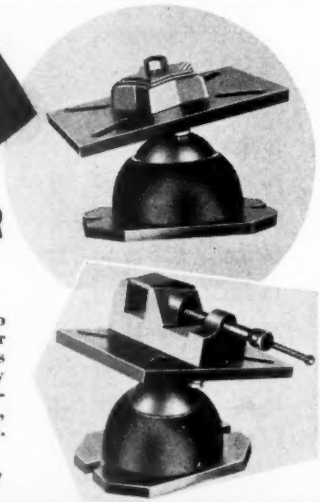

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Pre-Welding Cleaning of Aluminum

In searching for a satisfactory method of cleaning aluminum in preparation for welding with the inert-arc process, General Electric engineers recently found that dips in sodium hydroxide and sulfuric acid produce mirror-bright, fine-contoured welds as welded.

The first method tried at G. E. was wire-brushing, but this only folded the oxide and dirt into the surface of the aluminum. Next, sandpaper was tried. This was successful if all kerosene or lard oil which had been used as a lubricant in machining the aluminum had been completely removed before the sandpaper was applied. It was satisfactory for bulky work, but too slow and crude for cleaning small parts rapidly.

The logical answer seemed to be a chemical dip followed by washing, and nitric acid, which has been used extensively for aluminum brightening, was tried. However, when a sample was welded after being cleaned by this method the weld bead was sprinkled with a black substance which accumulated in small surface pits. The discoloration was easily brushed off, but the pits remained to mar the surface of the bead.

When it was determined that the specks were not caused by too great a percentage of nitrogen in the argon welding gas or from faulty power supply, it was deduced that the cleaning method was responsible. Since the specks were rich in nitrides, the nitric acid was blamed, and sulfuric acid was tried in its place.

After a brief degreasing in a five percent solution of sodium hydroxide to remove all grease, oil, or wax, and a brief wash in water to remove most of the caustic and scum, the aluminum was dipped in a fifty percent sulfuric acid bath. This completed removal of the oxide skin and restored most of the surface brightness, and a hot water bath removed the acid and left the aluminum clean and dry. Welding tests made on samples cleaned by this method resulted in mirror-bright, fine-contoured beads as welded.

Let Us Hope!

A project has been undertaken by the S A E Bumper Standardization Committee of the Automobile Manufacturers Association seeking practical preventatives for bumper locking and tangling and the resultant confusion, congestion and property damage in traffic and on parking lots.

The committee is surveying results of laboratory and field tests designed to reveal the most satisfactory bumper types, styles, construction features, dimensions and materials.

NMTBA

Herbert H. Pease, President, New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Conn., was elected President of The National Machine Tool Builders' Association at the Association's Annual Meeting held at the Chateau Frontenac, Quebec. Alexander G. Bryant, Vice President, Cleereman Machine Tool Company, Chicago, was elected first Vice President and L. D. McDonald, Vice President, The Warner

& Swasey Company, Cleveland, second Vice President. Louis Polk, President, The Sheffield Corporation, Dayton, was elected Treasurer. H. L. Tigges, Vice President and Sales Manager, Baker Brothers, Inc., Toledo, Mr. McDonald, and Mr. Polk were elected directors of the Association. Tell Berna continues as General Manager of the Association and Mrs. Frida F. Selbert as Secretary.

National Materials Handling Exposition

The first exposition to deal entirely with industry's materials handling problem, a phase of industry which represents approximately one quarter of all costs, will be held at the Public Auditorium, Cleveland, Ohio, January 14 through 17, 1947, it has been announced by Earl I. Burke, Republic Steel Co. manager of shipping and chairman of the packaging and loading committee of the American Iron and Steel Institute.

Mr. Burke, who is chairman of the policy committee of the first National Materials Handling Exposition, declared that the Exposition will furnish the first opportunity for production, distribution and warehousing executives to see under one roof all methods of speeding materials along production lines and through plants from receiving depots to shipping rooms.

"Materials handling is one of the last frontiers for cost reduction," said Mr. Burke. "Reliable estimates place the cost of handling alone at five billion dollars annually. It is expensive and nonproductive. In no other phase of manufacturing do there exist such possible savings in costs as in materials handling."

A four-day program of prepared papers and discussions will be held concurrently with the Exposition. On exhibition will be hoists, hoist mountings, cranes, derricks, conveyors, hand and power trucks, skids and pallets, tractors and trailers.

Edwin J. Heimer, president, Barrett-Cravens Co., Chicago, is chairman of the Exposition committee. Ezra W. Clark, vice president and general manager, Clark Tructractor Division of Clark Equipment Co., Battle Creek, Mich., is chairman of the program committee.

Magnesium's Tomorrow

A gradual reduction in manufacturing costs of magnesium products may be expected even though the general trend of materials prices is on an upward swing. Bases for this prediction were discussed by Dr. J. D. Hanawalt, general manager of the Magnesium Division of The Dow Chemical Company, who spoke at the opening day luncheon meeting of the Magnesium Association at the Waldorf-Astoria Hotel.

"Costs should come down," he said, "when a reasonably large and steady volume of production has been attained and new processing developments are more fully utilized." He pointed out that present costs are due to small scale production methods for cast, wrought and fabricated forms of the metal rather than to initial cost of the ingot.

Dr. Hanawalt emphasized that metallurgical discoveries will not bring large volume overnight, although many promising experimental developments such as electroplating, cladding and brazing of magnesium, and new alloys, will undoubtedly help the growth of the industry. The attainment of a volume of business sufficient to warrant continuous sheet rolling and automatic handling of the molten metal in foundries and die casting plants will come through sound engineering of magnesium into a wide variety of products in the industrial and consumer fields. The metal has already proven both serviceable and economical in many applications such as ladders, sporting goods and industrial equipment, as well as in the well established aircraft field.

"Use of the metal in commercial products," Dr. Hanawalt stated, "is rapidly increasing as designers and engineers become more familiar with its outstanding combination of lightness with other desirable properties, and consumption of magnesium in fabricated forms this year

is expected to be well over ten times the prewar volume."

Thirty-eight representatives of interested industries, government agencies, and the Army and Navy, meeting in New York, Wednesday, June 12, unanimously recommended that the American Standards Association should set up an American Standard numbering system for ball and roller bearings. The original request for this job had come from Secretary of the Navy Forrestal in a letter to the ASA of March 15th, together with a proposal that a code adopted by the Army and the Navy be adopted also by industry.

ASA Calls Conference on Anti-Friction Bearings

"The difficulties and wasted effort that a common numbering system would have eliminated during the war are not possible to estimate," Mr. Forrestal pointed out in asking for the job. "The cessation of hostilities has not lessened our need for such a system since it will contribute untold benefits to the general efficiency of operations under all conditions in the future."

The supply of anti-friction bearings was extremely important throughout the war because of their wide use in all types of mechanized equipment. The practice on the part of manufacturers of using their own numbering systems to identify the bearings they manufactured was throughout the war a serious source of confusion to the Armed Forces. "Procurement, interchangeability, and substitution were impossible in most cases due to lack of a common numbering system", said Mr. Forrestal.

The industry Conference that took place was called by the American Standards Association to advise it whether the interested industrial and governmental groups would back the ASA in carrying out Mr. Forrestal's proposal. The unanimous recommendation of the Conference will still have to be acted upon by the Standards Council of the American Standards Association; but it is customary for the Council to follow the recommendations of such a group.

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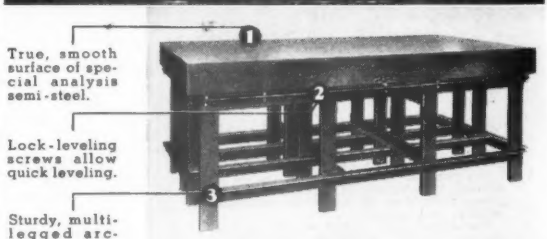

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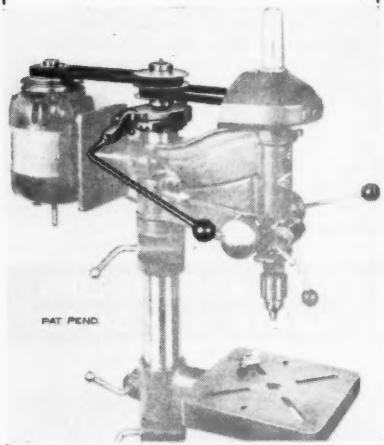
VARIABLE

SPEED DRIVE ATTACHMENT FOR DRILL PRESSES



The Era Variable Speed Drive enables the operator to provide correct speed for large or small drills by a convenient method of shifting a lever.

Designed to fit all popular makes of presses. Installed in a few minutes, without drilling of holes or changing present equipment.

Furnished with either bronze or ball bearing pulley, complete with belts.

When ordering be sure to specify make and model of press, also type of pulley desired.

Minimum and Maximum range of speeds obtainable, as follows:

Atlas 15	330/7780
Bolce Crane 15	275/10000
Buffalo 15	310/9300
Canedy-Otto 16	410/9250
Delta 14" L. S.	350/2240
Delta 14" H. S.	670/5500
Walker Turner 14" L. S.	360/3100
Walker Turner 14" H. S.	670/5500
Price—above Bronze bearing, $39.56; Ball bearing, $45.56	
Buffalo 18	260/4400
Delta 17" L. S. Old Model	320/2400
Delta 17" L. S. New Model	230/4100
Delta 17" H. S. Old Model	640/5000
Delta 17" H. S. New Model	460/6450
Walker Turner D-1100 H. S.	168/2880
Price—above Bronze bearing, $45.00; Ball bearing, $51.00	

Delivery from stock F.O.B. Chicago

WRITE FOR INFORMATION on other makes of presses

ORDER TODAY FROM YOUR DEALER OR FROM

ERA METER COMPANY

3940 N. Kilpatrick Avenue

CHICAGO 41, ILL.

BARKER WRENCHLESS CHUCKS

PRODUCE MORE AT LOWER COST!

Barker Wrenchless Chucks are made in two-jaw and three-jaw types, and as vises for milling machines, drill presses and similar purposes.

Production goes up—and stays up—when Barker Wrenchless Chucks go on the job. These chucks are simple, rugged, self contained units, that require no accessories, or outside source of power.

They are easy to install, and from the moment they are put in use they will deliver speedy, trouble-free service that pays liberal dividends—greater number of parts per hour, and lower cost per unit.

Precision built, they will hold to a tolerance of 1/1000" either way on round stock of uniform size. And, they will maintain such accuracy during many years of hard service.

For complete information write for Bulletin No. 201.

THOMAS HOIST CO.

Chuck Division

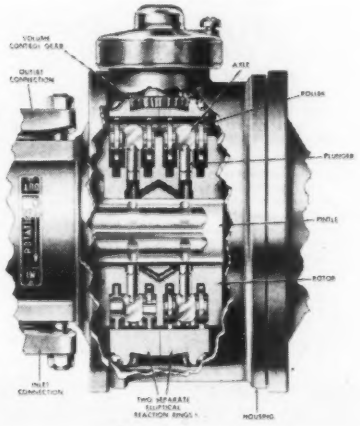
20 So. Hoyne Ave., Chicago 12, Ill.

Radial Type Plunger Pumps

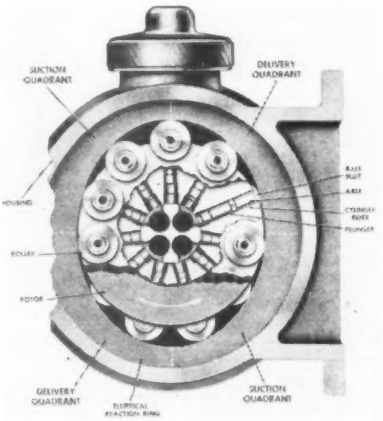
The war greatly accelerated technological advancement in most industrial fields, and hydraulic power transmission is no exception. Through a vigorous application of invention, engineering skill, research and capital investment, Superdraulic Corp. has written a new chapter in the book of hydraulic progress.

Superdraulic pumps, in constant or variable delivery types, are light enough for one man to handle, yet can develop 5000 psi and 40 hp, and have a delivery of 17 gpm at 1200 rpm. This doubles the pressures that have been available from the best of contemporary pumps.

They are radial type plunger pumps, arranged so centrifugal force maintans the plunger rollers in contact with an elliptical reaction ring. The plungers are fitted to cylinders in a rotor in one or more banks of eleven plungers per bank. The rotor turns on a fixed pintle which has suitable ducts and ports for directing the oil inlet into those cylinders passing through two opposite quadrants and also for directing the oil delivery out of those cylinders passing through the other two opposite quadrants.



Each plunger makes two inlet and two delivery strokes per revolution. In variable delivery pumps, two banks of eleven plungers each are arranged in a single rotor. The plungers in the two banks are arranged in parallel relation. Each pair



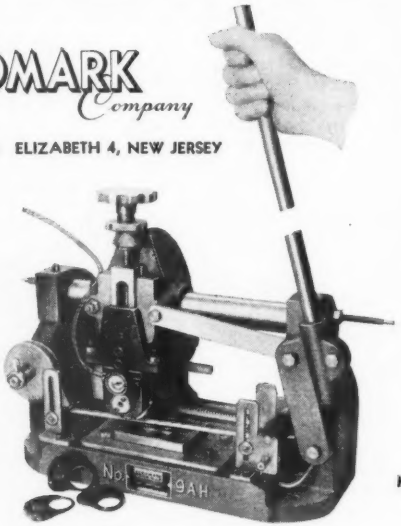
of parallel cylinders is in open communication by means of a drilled passage in the rotor. The plunger rollers, of each bank, roll against a separate elliptical reaction ring. These rings are rotatably mounted in the pump housing and geared together so they rotate in opposite directions in response to rotation of the volume control gear.

At full delivery, the major axes of the elliptical reaction rings are parallel, and at zero delivery, they are 90° apart. Under the latter condition, the net delivery stroke is zero, since the displacement of the plunger moving radially outwardly exactly equals the displacement of the plungers moving radially inwardly, in both the delivery and suction quadrants.

Superdraulic Corporation, Dept. 82, 12825 Ford Rd., Dearborn, Mich., will send complete specifications. INFORM-A-GRAM Key No. H82-R.

The ACROMARK Company

5-15 MORRELL ST. • ELIZABETH 4, NEW JERSEY



PRICES SAME AS IN 1941

MARKS—
Flat, Curved, Round, Tubular Parts of Plastic, Metal or Fibre

WRITE—
For Illustrations and Prices

SEND—
Sample Parts for us to MARK

MODEL
ACROMARK 9AH

SENSATIONAL, NEW, PRECISION MANDREL DESIGN . . . . OPERATION CYCLE SPEEDED — EXTRAORDINARY PRECISION

CURTISS-WRIGHT CORPORATION RANKS OUR PRODUCT WITH *THEIR* BEST TOOLS. CLEVELAND GRAPHITE BRONZE COMPANY, LEADING BEARING MANUFACTURER, STATES NEW HIGH ACCURACY REACHED, PLUS SUBSTANTIAL PRODUCTION BOOSTS.

WITH

YOUNG ROLLER CLUTCH PRECISION MANDRELS

Time-tested Overrunning Clutch —Patent Pending

Territories Just Opened to Representatives!

Shipments 2 to 4 Weeks

NO MORE "C" WASHERS, WRENCHES, DRAWBARS, NO MORE ARCS OR TAPERS BEFORE OR AFTER EXPANSION GRIP — CONCENTRICITY IN LOW 10,000ths — PRODUCTION OR INSPECTION.

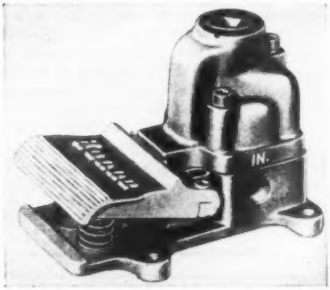
Assured parallelism of sleeve surface to center line —absolutely no variation in repeated mounting of parts — no tapers. Uniform full-work-length friction-locking gives complete control and contact of entire bore area. Slip part on mandrel with slight counter-clockwise motion, that's all — it's ready — Self-contained, self-expansion, self-locking, self-contraction. Instant unloading, no jamming, no adjusting — Interchangeable sleeves — Built to your bore tolerance high limit, with automatic contraction to low limit — Any mounting — Any machine operation — For bore diameters .500 and up — Reduces tool costs, extra equipment investment, operating costs, maintenance, down time, scrap, salvage. ROUGHLY SKETCH DESIRED MANDREL INTO YOUR PART PRINT AND FORWARD TO DEPT. TD FOR QUOTES. STATE BORE TOLERANCES.

YOUNG ARBOR CO., 3257 Bradford Road, Cleveland Heights 18, Ohio

Increased Efficiency Of Air And Hydraulic Control

Demands of increased control efficiency are met with three units designed by Hanna Engineering Works, pioneer manufacturers of air and hydraulic equipment. They are simple in construction, with minimum operating effort necessary.

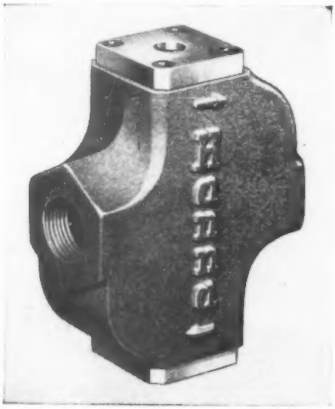
The Hanna Foot-Operated Valve, shown below, is a packless, effortless con-



trol for use in air and oil hydraulic cylinder applications. It is made in two styles—with single pedal for constant cycles of operation; with split pedal that holds position until tripped for reversal. It is available in three sizes, and operates on 250 psi air or 1,000 psi oil pressure.

For tubing and light piping applications, the Hanna Unitite Jr., a packless ¼" capacity valve, is precision-built, permanently tight, and designed for 4-way operation, but may be used as a 3-way valve. Shown in the lower left-hand corner, it is suitable for air, oil, or water in pressures up to 250 psi, for operating small pneumatic or hydraulic cylinders, or as a pilot control.

Installing the Hanna Two-Direction



Speed Control Valve, between the operating valve and end of a cylinder, provides adjustable control of inflow, as well as outflow of the air or oil, independently to and from one side of the piston. One valve controls the piston speed in two directions and is always sufficient for oil operation. When most effective control of an air cylinder is desired, two valves, one for each end of the cylinder, are used. Working pressures are 250 psi for air and 1,000 psi for hydraulic.

Literature and complete information are available by writing Hanna Engineering Works, Dept. 8-09, 1765 Elston Ave., Chicago 22, Ill., or use our postage-free INFORM-A-GRAM Key No. 809-R.

Standardize with these *TIME SAVERS* . . . Order Today

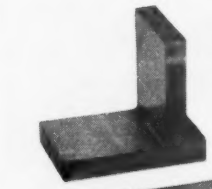
Do you ever need a fixture "yesterday"?

At one-half your cost to build, you can stock in your own tool crib any or all "27 Varieties" of Noble & Stanton's *standardized* Jig and Fixture Components in a full range of sizes to meet your every need—just as you stock drill jig bushings and cutting tools. These *standard* parts, "*The Chrome Plated Line*", supplied with full size templates for tracing, can save their cost in your designers' time alone.

Noble & Stanton's large production runs and careful quality control assure strength and durability at costs far below custom building. Furthermore, Noble & Stanton's "27 Varieties" of Jig and Fixture Components are made of steels best suited to each application. Also, they are processed to precision standards and, for your protection, they are heat treated and chrome plated wherever practical.

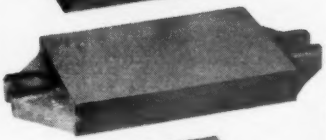
A price list and portfolio containing actual size drawings and specifications are available upon request.

IMMEDIATE DELIVERY



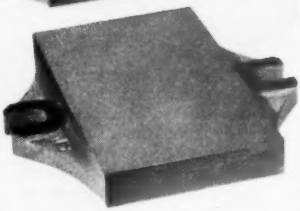
"T" ANGLE PLATES

	Capacity
Tap 1	2 x 2 x 2
Tap 2	2½ x 2½ x 2½
Tap 3	3 x 3 x 3
Tap 4	3½ x 3½ x 3½
Tap 5	4⅛ x 4 x 4
Tap 6	4⅝ x 4½ x 4½
Tap 7	5⅛ x 5 x 5



MILL FIXTURE BASES

	Capacity
MFB 2	6 x 9
MFB 4	8 x 12
MFB 6	10 x 15
MFB 8	12 x 18



GANG MILL FIXTURE BASES

	Capacity
GMFB 2	6 x 9
GMFB 4	8 x 12
GMFB 6	10 x 15

"27 VARIETIES"

The Chrome Plated Line

- Adjusting Head Screws
- Adjusting Half Nuts
- C-Washers
- Cam Action Clamps
- Clamp Rests
- Flange Nuts
- Gang Mill Fixture Bases
- Ground Thread Studs
- Heel Clamps
- Heel Clamp Assemblies
- Hand Knob Clamp Assemblies
- Hand Knob Clamps
- Hex Jig Feet
- Jig Feet
- Knob Shoe Assemblies
- Mill Fixture Bases
- Quarter Turn "Lightning" Clamps
- Quarter Turn Screws
- Rectangular Box Jigs
- Square Box Jigs
- Stud Drivers
- Swing Bolts
- Swing Clamps
- Spherical Washers
- Socket Head Shoulder Screws
- T-Angle Plate Fixtures
- Precision V Blocks

Three more of the "27 Varieties"

The above items are normalized cast iron precision machined and ground square and parallel within .001". Machined edge of Mill Fixture Bases parallel with keyways.
Full size drawings available on request.

Representatives in Principal Cities

NOBLE & STANTON, INC.
Manufacturers of Tools, Gages and Their Accessories
BEDFORD, OHIO
NS

TAP BREAKAGE *Reduced*

Square, Straight Tapping in Half the Time

The Dahlstrom Tap Guide practically eliminates tap breakage and saves wasted hours getting broken taps out of expensive dies. It does the job in a jiffy with work always straight and true. Just fasten it to a post or bench, slip a Tap Adaptor into the spindle, and even an inexperienced operator can handle it. Equipped with 7 Adaptors, ranging from 8-32 to ½". Taps not furnished. Ask your mill supply house, or $42.50 F. O. B. Minneapolis. *Literature on request.* Dahlstrom Manufacturing Co., 422 South Sixth Street, Minneapolis 15, Minn.

Dahlstrom **TAP GUIDE**

MEASURING A PLUG GAGE WITH LIGHT WAVES

using an optical flat, a toolmakers flat and a gage block

The formula is:

$$D = h + \left(.000012 \times N \times \frac{W}{w}\right)$$

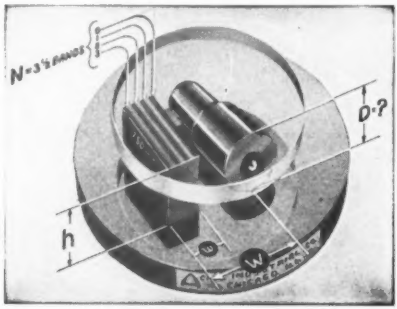
Substitute the actual values

$$D = .750 + \left(.000012 \times 3\tfrac{1}{2} \times \frac{1\ 7/16''}{23/64''}\right)$$

and get the answer

D = .750168 inch.

It's just that simple!



Write for new, free Lightwave Measurement Booklet.

ACME INDUSTRIAL COMPANY

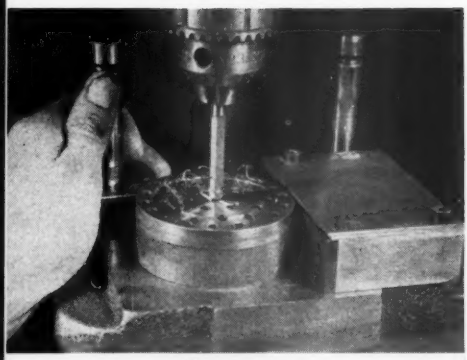
SCIENTIFIC DIVISION

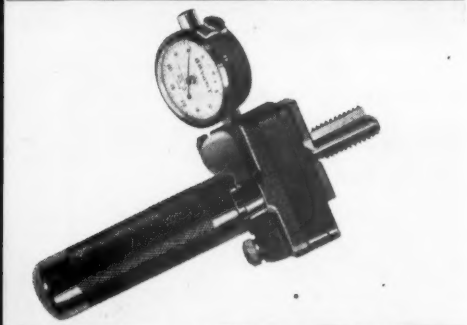
Makers of Standardized Jig and Fixture Bushings

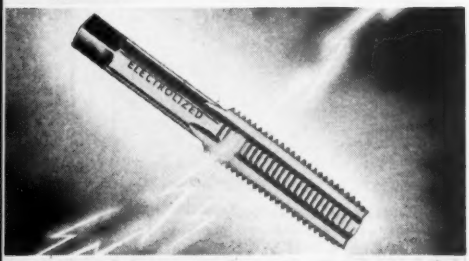
206 N. Laflin St. Chicago 7, Ill. MONroe 4122

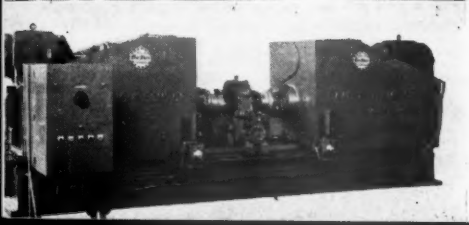
PROGRESS

NEW DEVELOPMENTS • IMPROVEMENTS • COST AND TIME SAVERS









FOR FURTHER INFORMATION FILL IN KEY NUMBERS ON POSTAGE-FREE INFORM-A-GRAM INSERT

SMOOTH, PRECISION DRILLING, REAMING, COUNTERBORING AND COUNTERSINKING are fulfilled with the Enesay Drill for cutting hard and soft metals. Practically break-proof, excessively fast or slow spindle speeds will not cause this versatile, dependable tool to break. Grinding may be done by hand on any wheel. Literature is available from ENESAY TOOL COMPANY, Dept. 25, 2240 Sepulveda Blvd., Los Angeles 25, Calif., or use INFORM-A-GRAM Key No. J25-R.

INSPECTION OF INTERNAL THREADS in parts where bench inspection is inconvenient or while parts are still in the machine is made possible by the Bryant Portable Thread Gage. Two stationary and one movable segment engage with the internal threads, thereby showing on dial overall accuracy, accumulated inaccuracies of lead, pitch diameter, thread form or presence of burrs. Full data can be had from BRYANT CHUCKING GRINDER COMPANY, Dept. 71, Springfield, Vermont, or use INFORM-A-GRAM Key No. C71-R.

COMBINING HIGH VOLTAGE with a chemical bath and a rare metal produces a hard case on cutting edges and entire surface of high speed taps. The case Rockwells approximately 83 on the C scale without being brittle, and is a thin deposit of a hard alloy, which reduces chip and surface friction and increases life of the tap. Available in standard sizes, complete information is available from ELECTROLIZED TAP CORPORATION, Dept. 42, 148 West River St., Providence 1, R. I., or use INFORM-A-GRAM Key No. J42-R.

BORING, FACING, CHAMFERING AND COUNTERBORING are accomplished on electric motor frames in one setup with the 2W Way Type Two Head Boring Machine. Five minutes completes operations on size 254 motor frame, all other frame sizes in proportion. During all operations, coolant is fed to work. Cutter spindles are 12" in diameter and are taper bearing mounted. Request further information from DAVIS & THOMPSON COMPANY, Dept. 21, 6411 W. Burnham St., Milwaukee 14, Wis., or fill in INFORM-A-GRAM Key No. 21-R.

HYDRAULIC AND PNEUMATIC EQUIPMENT pressure of 3,000 psi can be held by a new

ON PARADE

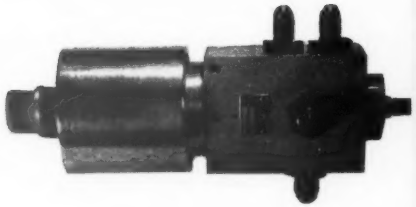
line of solenoid operated valves. The ¼" 4-way valve shown has provision for manual over-ride and a total pressure drop of 30 psi at 1.2 gpm flow. A complete series of solenoid operated on-off and special cycle valves for 3,000 psi service are available. Write THE SAVAL COMPANY, Dept. TDJ, 1915 E. 51st St., Los Angeles 11, Calif., or use INFORM-A-GRAM Key No. J43-R.

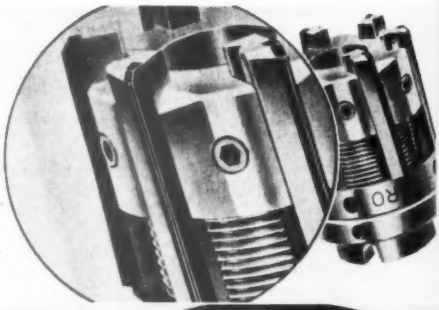
REAMING OPERATIONS AT HIGH SPEEDS are permitted by full-length carbide cutting edges of heavy duty solid shank and shell type expanding reamers, also available in blades with high speed steel. Designed with a low expansion angle and a 1/16" blade overhang, they are available in cutting diameters of 1" to 6". Descriptive information, specifications and prices are furnished by METRO TOOL AND GAGE CO., Dept. 9, 4240 W. Peterson Ave., Chicago 30, Ill., or use INFORM-A-GRAM Key No. 9-R.

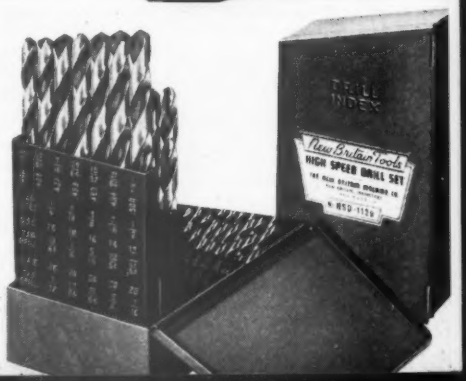
EXTRA MAGNIFICATION for precise work is provided by the Double Utility Hi-Power Magni-Focuser, successfully used in many trades. A hi-power auxiliary lens which drops in front of one eye can be flipped up when not in use. The shade shuts out overhead and side glare, thus promoting depth perception needle-sharp clarity carried on with the binocular lenses. The model is available from EDROY PRODUCTS COMPANY, Dept. 13, 480 Lexington Ave., New York 17, N. Y., or use INFORM-A-GRAM Key No. D13-R.

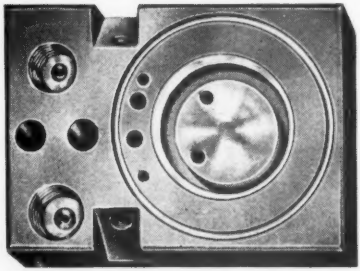
TIME IS SAVED IN THE DRILL DEPARTMENT by using New Britain Drills in Huot Indexed Containers which afford visible arrangement of proper size. The alloy steel, twist drills, uniformly hardened, accurately ground, stand up when box is open, lie flat when closed. They drill in hard or soft steel with ease and resist heat strain. A complete catalog from THE NEW BRITAIN MACHINE CO., Dept. 20, New Britain, Conn., is offered, or use INFORM-A-GRAM Key No. B20-R.

SPEED TREAT STEEL may now be obtained in standard sized rolled flats. This steel has found wide acceptance in the production of parts where machinability, uniform hardenability, high tensile strength, and "mirror finish" are desired. These flats enable the user to save the cost of torch cutting when narrow stock is needed, and at the same time, stress relieving necessitated by torch cutting is eliminated. A typical example of the use of these flats is the base of a 30-ton capacity hydraulic jack illustrated above. W. J. HOL-







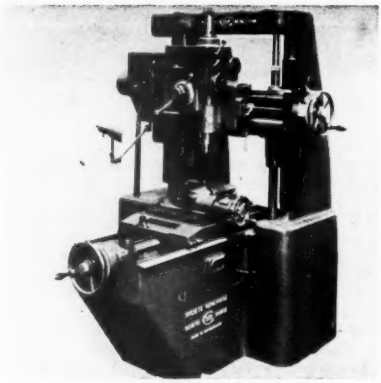


LIDAY & CO., Dept. 3-21, Hammond, Ind., will send Bulletin 446 upon request, or use INFORM-A-GRAM Key No. 321-R.

AN "AIR-HORSE" RIVETING HAMMER is now available with either an offset or grip type handle in any of three sizes for light, medium, or heavy duty riveting. Excessive operation of the Air-Horse only accelerates its

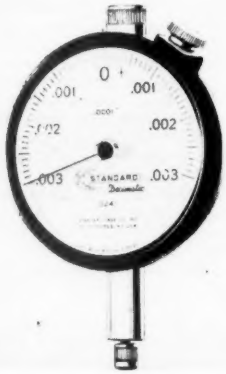
air cooling process for air exhausted from the operating head's front expands as the tool is operated. A beehive retainer spring, hand screwed to this hammer, will hold the proper tool for caulking, scaling, chipping and other work. Complete information will be furnished on request from IDEAL INDUSTRIES, INC., Dept. 30, 4151 Park Ave., Sycamore, Ill., or use INFORM-A-GRAM Key No. H30-R.

HIGH PRECISION BORING, ease of operation and accurate measuring are features built into the new SIP Jig Borer, Type 3K. There are no loose instruments to be handled for locating hole centers and direct readings are made to 0.00005" on the verniers of large divided drums. Automatic correctors compensate for any source of error in the measuring devices and there is an accuracy of 0.0002" for all settings of the work table and spindle



saddle. For full details write COSA CORP., Dept. 2-50, 405 Lexington Ave., New York N. Y., or use INFORM-A-GRAM Key No. 250-R.

PRODUCTION AND INSPECTION ADVANTAGES ARE GAINED through the Decimatic series of dial indicators for fine tolerance checking. Modified range eliminates failure to notice a complete revolution of the hand. These



instruments are free from noticeable whip and waver of the hand, and operate under exceptionally low tension. Specifications on 19 different models are available from STANDARD GAGE CO., INC., Dept. 78, Poughkeepsie, N. Y., or use INFORM-A-GRAM Key No. B78-R.

NUMEROUS LIGHT BURRING AND GRINDING OPERATIONS can be performed with the Porter-Cable light, narrow belt grinder attachment, type N-2. Versatile, swift and ideal for light grinding of flats, arcs, angles, gear

WHICH CLAMPING DEVICE MEETS *Your* NEED?

Do you have to hold small assemblies for drilling or welding? Are you required to hold work at odd angles? Is clamping space limited? Must you exert great pressure to hold parts?

In a word: What are your clamping problems?

Knu-Vise, through many years, has learned the most efficient way to coordinate clamping operations with production requirements; and this background of experience can be made valuable to you.

Knu-Vise toggle-action clamping devices (only a few shown here) are recognized for their bull-dog grip and quick release, and their capability of simplifying and increasing production.

Ask us for any help you need in clamping operations. In the meantime, would you like a catalog?

KNU-VISE INCORPORATED

1330 PLUM ST. DETROIT 16, MICH.
4328 SAN FERNANDO RD. GLENDALE, CALIF.

Substitute TIMESAVER LAPPING COMPOUND

For Expensive Hand Scraping and Running-In Operations

A gear lapped to precision, in assembly, with Timesaver Compound

PRODUCE PERFECT FITS
ASSURE QUIET OPERATION

You can produce perfect fits, assure quiet operation and save time and money by substituting Timesaver Lapping Compound for expensive hand scraping and running-in operations.

Timesaver is easy to use and rapidly produces perfect fitting bearing surfaces.

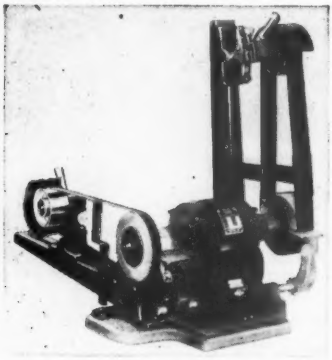
Timesaver Compound will not imbed into any metal nor will it continue to cut.

Used by leading manufacturers for the past twenty-seven years for the fitting of all types of gears, bearings, valves, pistons, slides, etc.

Grades for lapping hard and soft metals.

A request on your letterhead will bring FREE SAMPLES and complete data.

TIMESAVER PRODUCTS COMPANY
31 S. Desplaines St. ◆ Chicago 6, Illinois



burring, weld grinding, etc., it will grind and surface a variety of materials. Furnished without motor, it is aligned and attached to the bench type wheel grinder, to which a resilient contact roll has been fitted. PORTER-CABLE MACHINE CO., Dept. 14, Syracuse, N. Y., offers literature or use INFORM-A-GRAM Key No. 14-R.

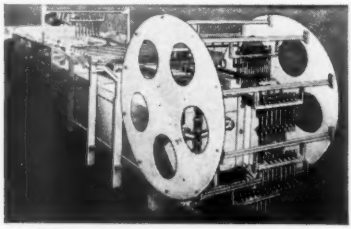
A TWEEZER SPOT WELDING MACHINE now facilitates welding of tiny parts by direct application of tweezer tip electrodes to the elements being joined. Though the tweezers

serve to probe for, hold, bend, and weld parts, even with continuous use they remain cool enough to handle easily. For the fabrication of metal parts ranging in thickness of from .0005" to .125", the Besco machine and spot welding tweezers are extremely simple to use. Complete catalog information is available from THE TWEEZER-WELD CORP., Dept. 70, 280 Plane St., Newark 2, N. J., or use INFORM-A-GRAM Key No. H70-R.

LATHE GRINDING, DISC SANDING, SNAG GRINDING AND POLISHING are operations which can be performed on a new line of machines developed by Bradford Machine Tool Co. The grinder illustrated is a new design with heavy duty features and safety equipment to meet the American Standard and Safety code. For complete information write

for bulletin and engineering data to BRADFORD MACHINE TOOL CO., Electrical Tool Div., Dept. C, Evans St., Cincinnati, Ohio, or use INFORM-A-GRAM Key No. 215-R.

CYANIDE HARDENING ENDS OF CONTROL LEVERS and most types of parts is attained with a continuous salt bath furnace with auto-



matic quenching mechanism. Quenching operation, completed in 4 seconds, may be changed to meet metallurgical requirements. The machine can be provided with oil, water or hot salt quench tanks, and an unloading mechanism can be provided. Complete information may be had from THE BELLEVUE INDUSTRIAL FURNACE CO., Dept. 47, 2971 Bellevue Ave., Detroit 7, Mich., or use INFORM-A-GRAM Key No. J47-R.

A WIDE RANGE OF OPERATIONS is covered with an axial relief grinding fixture

"Fluidmotion"* Radii and Angle Dressers

are the choice of

LIONEL CORPORATION

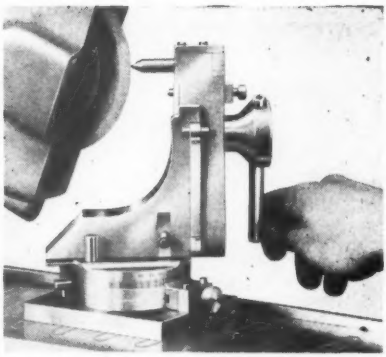
FOR 4 REASONS

1. Exceptional accuracy of "Fluidmotion" in all phases of form dressing.
2. Much easier set-up and operation.
3. "Fluidmotion" allows them to dress the entire angle – radius-angle profile on wheel in one *continuous motion* —with just one set-up.
4. Substantial saving in wheel cost, since accuracy results in less material being removed at each dressing.

These results are obtained by many other manufacturers who likewise make "Fluidmotion" their choice.

FEATURES: *.0001" accuracy*
Automatic centering
"Fluidmotion" dressing
Dustproof and chatterless
7" and 14" wheel capacities

*REG. U. S. PAT. OFF.



• HARDENED STAINLESS STEEL •

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J & S TOOL CO.

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Representatives in Principal Cities

DRILL JIG BUSHINGS

Accurate Interchangeable Concentric

Acme Industrial Company

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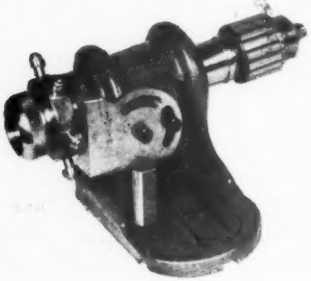
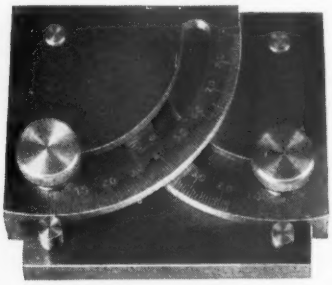
adapted to performing operations formerly requiring a variety of grinding fixtures. Adjustments are simple, visual and external, the fixture being convertible from right- to left-



hand, and vice versa. It can be used on surface and cutter grinders with standard grinding wheels. Complete details are obtainable from GOVRO-NELSON CO., Dept. 8, 1931 Antoinette, Detroit 8, Mich., or by using INFORM-A-GRAM Key No. E8-R.

A DUAL CHANGE OF ANGLES from 0° to 90° is provided by a universal angle protractor which can be used on all makes of carbide tool grinders. Simultaneous grinding of

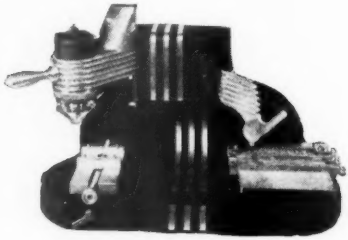


two tools at same or different angles is permitted thereby speeding up production. The protractor also acts as an angular guide for drilling, grooving and milling. An inquiry to WILLEY'S CARBIDE TOOL CO., Dept. 5-51, Detroit, Mich., will bring further information, or use INFORM-A-GRAM Key No. 551-R.

VARIFYING CORRECT CUTTING ANGLES, exact clearance angles, and uniform length of cutting lips on all tools up to 1" in diameter, are uses for which the Opti-Check has been designed. It can also be used for checking drills, reamers, counterbores, milling cutters, forming tools, and lathe tools. Angular measurements on cutting tools are taken by holding

the tool in contact with a straight edge mounted on the Opti-Check base and aligning precision guide lines in an optical viewer with the cutting edge. Readings are then taken directly from a protractor scale. Complete details will be sent on request to the BENTON CO., Dept. T, 351 S. La Brea Ave., Los Angeles, Calif., or use INFORM-A-GRAM Key No. G18-R.

AUTO ENGRAVERS for commercial and industrial use are introduced by the Auto Engraver Co. With precise, smooth lines, the Super-Cut Model D-3 engraves designs, numerals and letters on brass, copper, aluminum, soft steel, and all plastics. Besides drilling small holes of multiple series, the Auto Engraver accurately profiles small parts, channel cuts panels for wire insertion, and traces paper drawing designs as well as those of

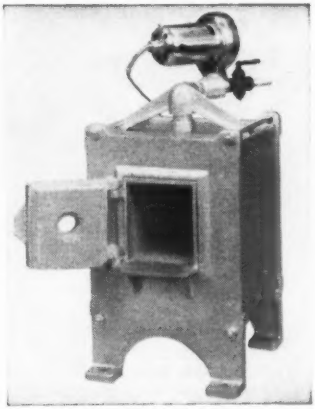


master templates. Descriptive literature will be sent on request from AUTO ENGRAVER CO., Dept. 1-96, 1776 Broadway, New York 19, N. Y., or use INFORM-A-GRAM Key No. 196-R.

HAND FORGED DEBURRING TOOLS, suitable for non-ferrous, hard metal work, and plastics, are now available in a variety of sizes

NEW

High Temperature Burner Furnace Heats Faster . . . . Saves Money



THE MIDGET UTILITY FURNACE

Heating chamber 4½" wide, 5¼" high, 9" deep; extra depth easily obtainable by change of plates; entire lining of standard insulating fire brick.

Here's a small, rugged bench furnace that's ideal for hardening small parts and tools, forging soldering coppers, general forging, brazing and a wide variety of other jobs. Because of its new type, high temperature burner it heats very quickly, saves real money. Complete rapid combustion; wide temperature range; maximum turn-down; burns any fuel gas; *2400° F in 12 minutes.* Equipped with blower (110v. AC-DC motor). Also available with mixing tee for compressed air (2 lbs. or more) or inspirator for high pressure gas.

GAS APPLIANCE SERVICE, INC.

Flame Hardening with City Gas and Air
Industrial Gas Engineers
1205 Webster Ave. Chicago 14, Ill.

Use the right blade

STAR MAKES IT!

Star makes blades for cutting everything a hack saw or band saw can cut —a *complete* line. That's why your Star supplier can tell you—quickly, expertly —what Star Blade will do your job best!

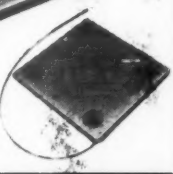
Free Booklet of Hack Saw Hints. *Specifications, tips on use, prices. Free from Star suppliers.*

★ **HAND BLADES**

★ **POWER BLADES**

★ **FRAMES**

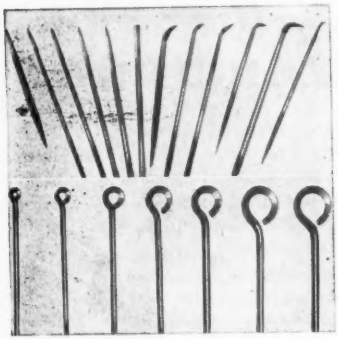
★ **BAND SAWS**
(including skip-tooth)
(metal and wood cutting)



CLEMSON

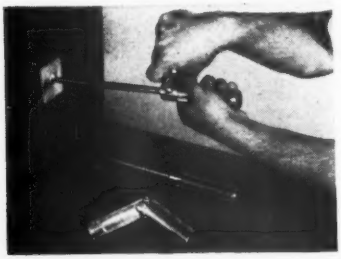
CLEMSON BROS., Inc., Middletown, N.Y.
Makers of hand and power hack saw blades, frames, metal cutting band saw blades and the Clemson D-17 lawn machine

and shapes. Hand propelled, these tools provide access to places unreachable by means of power or flexible shaft tools. Tests have proven that patented Metal Products deburring tools are especially adaptable for work on deep slots, bottom surfaces, chamfering around



casting hole ID's, recessed and top holes, and long channels. Complete information is available from THE METAL PRODUCTS CO., Dept. 27, South Bend 24, Ind., or use INFORM-A-GRAM Key No. H27-R.

A POWER-ARM SCREW DRIVER. Tuffy the triple purpose tool, is so much more powerful than ordinary screw drivers, it easily unlocks formerly unbudgable rusted screws. In reverse, Tuffy accomplishes the last quarter turn of pressure needed to tighten screws so they stay put. With the power-arm folded into the handle, this tool becomes a standard type screw driver. Complete details are available

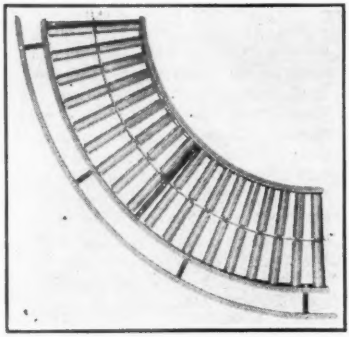


from the SWALLOW AIRPLANE CO., INC., Dept. 28, Wichita, Kansas, or use INFORM-A-GRAM Key No. H28-R.

AUTOMATIC RADIAL GUARD is designed to give complete and automatic coverage of portable emery wheels, wire brushes, etc., with the exception of the working surface. Its flexibility makes it applicable to most all portable rotary grinding tools. It provides adequate protection to both the operator and adjacent workers. Full details may be obtained from

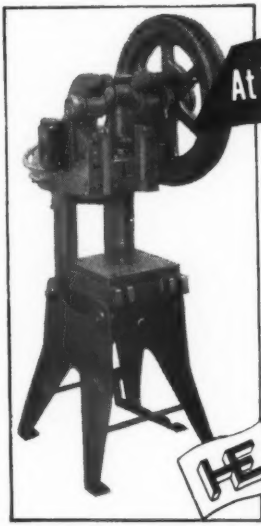
FLOHR MANUFACTURING COMPANY, Dept. 84, 2221 Elmwood Ave., Buffalo 17, N. Y., or use INFORM-A-GRAM Key No. H84-R.

GRAVITY ROLLER CONVEYORS packaged in individual sections are introduced by Lyon Metal Products. Their balanced design renders modern Lyon conveyors lighter of weight than formerly. Though easily portable, the trestles will support this conveyor's maximum weight capacity which is a "safe" load of up to 200 lbs. Detailed specifications will be furnished



on request from LYON METAL PRODUCTS, INC., Dept. 7, Aurora, Ill., or use INFORM-A-GRAM Key No. B7-R.

INSTANT AND WIDE-SPREAD ACCEPTANCE, throughout the tool and die industry, has been extended to the Keckley Hydraulic Die Try-Out Press. Hydraulically operated and pro-



At last..a light punch press for large jobs!

20 TON CAPACITY!
7 INCH SHUT HEIGHT **3 INCH STROKE**

Designed to meet war production needs, this new Highland all steel punch press is *now available!* Because of its long stroke, 3", and its ample shut height of 7", this punch press handles those lighter tonnage jobs which heretofore had to be run on larger presses. The new Highland inclinable punch press features a 12" x 12" bolster with a 4½" diameter plug as standard equipment, an open back, a non-repeating trouble free clutch, and heavy bronze bearings. The highly stressed parts are made of 4140 alloy steel machine finished and heat treated to optimum tensile strength. The frame is made of welded and normalized 1" steel, heavily reinforced. A slight modification in the clutch mechanism will allow for automatic operation at 120 strokes per minute. The entire press occupies approximately 3½ square feet of floor space and weighs 800 lbs. (less motor).

Write today for illustrated folder and further information —

HIGHLAND ENGINEERING CO.
1734 Berkeley St. Santa Monica, California

YOUR SYMPTOMS.....
.....OUR PRESCRIPTION

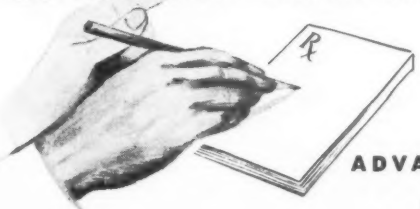
After diagnosing your drawing and forming requirements, we prescribe the type of ***Strenes Metal*** to fit the case.

By making slight changes in the formula, we are able to give ***Strenes Metal*** special characteristics in hardness, toughness, density, temperability, acid resistance, magnetic qualities, etc.

Strenes Metal cast dies have saved a lot of money for manufacturers of appliances, automobiles, blowers, caskets, implements, tractors, trucks, and vaults.

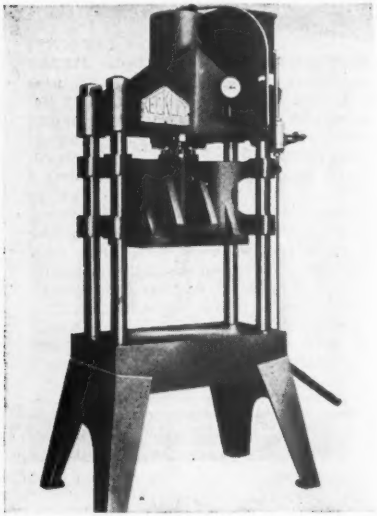
It will pay you to discuss your die problems with us. No fee for consultation, of course!

Strenes Metal **DRAWING AND FORMING DIES**



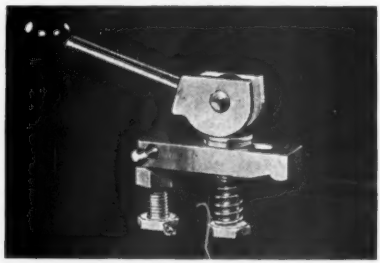
THE
ADVANCE FOUNDRY
COMPANY
DAYTON 3, OHIO

vided with a double-acting cylinder on the down stroke, smooth hydraulic pressure eliminates a bar or pry to spread the dies.



Punch is brought down to the die through the Keckley Prefill System. Address inquiries for literature to O. C. KECKLEY COMPANY, Dept. 64, 400 West Madison St., Chicago, Ill., or use INFORM-A-GRAM Key No. J64-R.

DESIGNING WORK HOLDING FIXTURES is simplified by the Wespo fixture clamp. These clamps have ground stud washers with ground spherical radii—allowing the clamp to float and so compensate for irregularities in



the work. The makers are offering exact scale template drawings of each type and size which enables tool designers to include the right clamp in their fixture design, saving both in designing time and fixture cost. Details and specifications are available on request from WEST POINT MANUFACTURING CO., Dept. 41, Farmington, Mich., or use INFORM-A-GRAM Key No. J41-R.

A SINGLE SHANK plus six screw-type interchangeable noses are the parts of the new patented machine center set being manufactured and marketed by the Black Drill Co. After the shank is placed, it is not removed:

noses are simply changed to meet the work requirements. This device saves time and eliminates shank wear. Get other details by writing to BLACK DRILL CO., DIVISION OF BLACK INDUSTRIES, INC., Dept. 5-88, Cleveland, Ohio, or use INFORM-A-GRAM Key No. 588-R.

BEING ABLE TO FOLLOW VARIATIONS in dimensions as small as one-hundred thousandth of an inch, the "Super" sensitive dial indicator is being manufactured by the B. C. Ames Co. Used as a master check, both in the

toolroom and on the production line, the new indicator has a diamond contact, suiting it to surface analyzing. Write to B. C. AMES CO., Dept. 1-89, Waltham 54, Mass., for special data, or use INFORM-A-GRAM Key No. 189-R.

SEVEN HOLES OF VARIOUS SIZES can be drilled in one cycle through the combination of a Zagar 2000 Series 7-spindle Gearless Drill Head and a 1" capacity Zagar five-station Index Fixture. As a finished part is removed, a new one is loaded and four other parts are drilled simultaneously. Steps of the operation

SHORT-CUT TO IRREGULAR SHAPES

THE HEINRICH HEAVY-DUTY

HANDNIB

A Hand Operated Combination Nibbling, Shearing, Punching and Rod Cutting Machine. (With swivel base)

Capacity: Nibbling and Shearing 3/16" flat stock . . . Punching Holes up to ½" in ⅛" sheets . . . Rod Cutting 3/16", ¼", 5/16" and ⅜" round bars. *Ask for Descriptive Folder.*

NATIONAL MACHINE TOOL CO. HEINRICH

THE NATIONAL MACHINE TOOL CO.
1536 CLARK STREET • RACINE, WISCONSIN

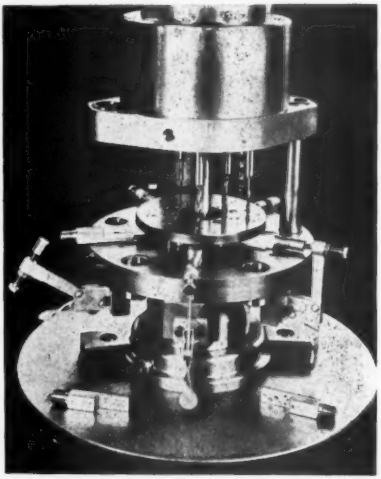
GIBSON "KNOW HOW" DEVELOPS BETTER SPRINGS

—utilizing new and old materials in new designs to save space and weight—often with increase in spring life, capacity and efficiency.

Range of effective usages has been considerably increased. More intricate shapes and bends are now possible. Heat treatment and heat setting have been greatly refined. *Investigate!*

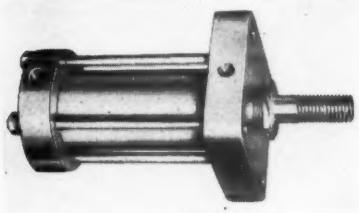
GIBSON-SPRINGS

THE WILLIAM D. GIBSON CO.
(DIVISION OF ASSOCIATED SPRING CORPORATION)
1800 CLYBOURN AVENUE CHICAGO 14, ILLINOIS



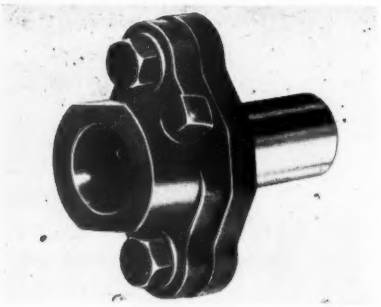
as applied to various needs are described in detail in Bulletin TDJ by ZAGAR TOOL, INC., Dept. 6-50, 23880 Lakeland Blvd., Cleveland, Ohio, or use INFORM-A-GRAM Key No. 650-R.

APPLICABLE WHERE FORCES OF PUSH, PULL, LIFT, or pressing are directly or indirectly needed, a new line of air cylinders is



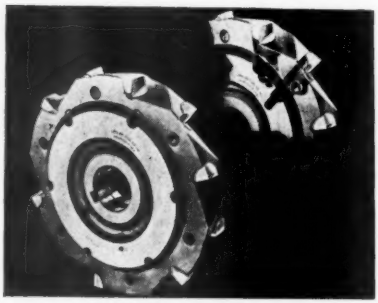
now being produced by the Oakland Engineering Co., Inc. Special features are drilled mounting holes, stronger heads and steel tie rods, standard oil and moisture proof leather or asbestos cups. Detailed catalog may be requested from the OAKLAND ENGINEERING CO., Dept. 72, 800—100th Avenue, Oakland 3, Calif., or use INFORM-A-GRAM Key No. J72-R.

COMPLETE INTERCHANGEABILITY OF REPLACEMENTS is assured with the new Boyar-Schultz Adjustable Drill and Reamer Holder, made to close precision dimensions. Designed to take the strain of heavy production runs, this holder has hardened and ground mating surfaces to enable quick and easy timesaving

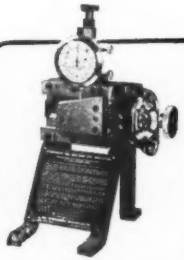


adjustments. Special data will be sent upon request by BOYAR-SCHULTZ CORP., Dept. 6-12, 2112 N. Walnut St., Chicago 13, Ill., or use INFORM-A-GRAM Key No. 612-R.

SENSITIVE CONTROL OF BLADE SETTINGS in Lovejoy slotting cutters is obtained by the addition of a screw adjustment to the blade



"positive-locking" device. When blade adjustment is required, either for resharpening or for the exact control of slot width tolerances during milling, the "positive-locking" device is loosened by unseating the taper pin. A recessed-head screw, at the bottom of each blade, is then turned to move the blade up (or retract it) the exact amount required. Savings on carbide are affected when resharpening because each tip need be moved up only a sufficient amount to be cleaned up. An additional long-life provision is the extra large tungsten tip on the blades. The rigidly constructed forged steel body, plus the Lovejoy "positive-locking" device, enables the blades to withstand heavy or intermittent cuts without loosening or breakage. Details and specifications on this cutter will be sent by the LOVEJOY TOOL CO., INC., Dept. 28, Springfield, Vt., or use INFORM-A-GRAM Key No. 28-R.



CLARKATOR CHECKS DIAL INDICATORS

CLARK

Gives Continued Accuracy, Rapid Measurements

THE CLARK has everything you want in a hardness tester—direct reading precision dial, durable construction, ease of servicing. Three standard models shipped complete with weights, dust protectors, diamond and steel penetrators, test blocks, and anvils.

CLARKATOR CHECKS DIAL INDICATORS with micrometer speed and sine bar accuracy. Easy to operate—just four simple steps. Complete instructions permanently fastened to base.

CLARK HARDNESS TESTER

MASTER DIAMOND CHECKING SET

MASTER DIAMOND CHECKING SET eliminates hardness tester errors. Consists of a master diamond penetrator and two test blocks. Precision is assured over a long period because the set is used only for checking. Furnished in leather case.

Learn the truth about hardness testing! This 20-page reference manual (right) contains information on history, theory, practice, and equipment for modern hardness testing. Available to executives without charge. Write Dept. MMS today!

CLARK INSTRUMENT, INC.

10200 Ford Road. • Dearborn, Mich.

for **PEACETIME PROFITS**

With Dickerman Hitch Feeds for your punch presses, you'll get top production at rock-bottom cost. They are accurate, reliable and easily changed from one die to another. Send now for descriptive booklet.

DICKERMAN HITCH FEEDS

H. E. DICKERMAN MFG. CO., 321TD Albany St., Springfield, Mass.

Hard-Face Your FORMING DIES *with the NEW* COLMONOY SPRAY-WELD PROCESS

Dies Spraywelded with Colmonoy *ALMOST* last forever

It is the unanimous feeling of those who hard-face their dies by this method.

The Colmonoy Sprayweld Process unites welding and metallizing practices. Colmonoy No. 6 is first sprayed on the die surfaces to be faced. By this method, the exact amount of overlay can be applied smoothly and uniformly. This overlay is then fused to the base metal with an Oxy-Acetylene torch to obtain a fusion bond identical to that obtained when the same alloy in rod form is applied by welding. The final result is a smooth uniform overlay, free from porosity, and requiring very little if any finishing, before being put in service.

The Colmonoy Sprayweld Process may be used for parts of almost any size, ranging from large dies, like the one shown in the picture, to small plug gages. About the only limits to the Process is the ingenuity of the user.

The Colmonoy Sprayweld Process may be executed in one of two ways, by

(1) The New Colmonoy Spraywelder, which is used to spray Colmonoy No. 6 in Powdered Form. The Spraywelder is a new powder-spraying unit developed by Wall Colmonoy Corporation, for use with the Sprayweld Process.

(2) Colmonoy Plastic Bonded Rod, which can be used in conjunction with standard wire metallizing equipment.

For full information on the Colmonoy Spraywelder Process, or the sensational new Colmonoy "Spraywelder", write to

WALL COLMONOY CORPORATION

7TH FLOOR FISHER BLDG., DETROIT 2, MICH.

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RUST IS INEVITABLE WHEN FERROUS METALS are exposed to air, but not when they are protected by No-Rust, the protective coating that is designed to withstand extreme temperature changes, the heaviest downpour of rain, salt air, and rough handling. Easily applied to bare or painted surfaces by spraying, brushing, or dipping, it dries in 15 to 30 minutes, netting protection indefinitely. Yet, it can be removed instantly with gasoline or kerosene. Producing a hard flint-like surface, No-Rust is never sticky, therefore foreign substances will not adhere to the surface. You can get more information about this product from FROST PAINT AND OIL CORP., Dept. 70, 1209 N. E. Tyler St., Minneapolis, Minn., or use INFORM-A-GRAM Key No. J70-R.

A COMPLETE SERVICE FOR THE DESIGNING and building of gages, special tools, dies, jigs, fixtures, and special machines is rendered by The J. C. Ulmer Company, now in its fiftieth year. Originally established as a manufacturer of precision instruments, today this company specializes in extensive precision service. Write for the story of their progress to THE J. C. ULMER COMPANY, Dept. 6, 1791 E. 38th St., Cleveland, Ohio, or use INFORM-A-GRAM Key No. F6-R.

INCORPORATING THE PRINCIPLE of the centerless grinder, the Steinle Centerless Thread Generator employs revolving twin hardened rolls to displace, and not remove, metal. Quickly changed from one setup to another, this machine, used successfully by precision manufacturers, does not require a skilled operator. Study the details and illustrations of the descriptive booklet put out by THE STEINLE MACHINE COMPANY, Dept. 58, Hartford, Conn., or use INFORM-A-GRAM Key No. J58-R.

MEETING THE NEED for a simple and accurate machine die to produce at high speeds identical threads on interchangeable parts, the "Acorn" Die has been developed by the Greenfield Tap and Die Corporation. These factory tested dies are easily set up, sharpened, and adjusted concentrically. The latest material about "Acorn" dies is available from GREENFIELD TAP AND DIE CORPORATION, Dept. 1-08, Greenfield, Mass., or use INFORM-A-GRAM Key No. 108-R.

SIMPLIFIED PRACTICE FOR INDUSTRIES USING ABRASIVES is reviewed in conjunction with specific jobs in the new Armour catalog, "Coated Abrasives." These products conform to the U. S. Department of Commerce Simplified Practice Recommendations R89-40. The catalog may be obtained by contacting ARMOUR SANDPAPER WORKS, Dept. 2, Chicago, Ill., or use INFORM-A-GRAM Key No. H2-R.

DESIGNED FOR THE AVERAGE JOBBER as well as purchasing executives and engineers, the 32-page catalog, "Mid-West Dependable Abrasives," gives a cross-index of weights, textures, and unit prices, corresponding to illustrated descriptions of abrasives, grinding wheels, and sharpening stones. Write for literature to MID-WEST ABRASIVE CO., Dept. 3-94, Owosso, Mich., or use INFORM-A-GRAM Key No. 394-R.

ENABLING THE DRAWING OF RADII WITHOUT USING A COMPASS, two new templates have been devised and announced by Rapidesign, Inc. The desired radius is merely placed tangent to the ends of the lines to be joined and the radius stencilled by following the curve. Radius Guide gives radii up to ¾"; Radius Master, up to 37-32nds in increments of 1/32". Further details about these instruments are available from RAPIDESIGN, INC., Dept. 66, P. O. Box 592, Glendale, Calif., or use INFORM-A-GRAM Key No. H66-R.

AN UNSKILLED OPERATOR can turn out a perfectly ground spiral point in a very short time by using the Blake Flute Grinder which easily and accurately sharpens both straight and angular fluted tools. The new Blake grinder is safer, also leaving the operator's hands and body free of the grinding wheel; all dust is blown downward into a coolant collector pan. Bulletin 466 giving details is available upon request from the EDWARD BLAKE CO., Dept. 79, 634 Commonwealth Ave., Newton Centre 59, Mass., or use INFORM-A-GRAM Key No. 79-R.

POWER, SPEED, STRENGTH, AND ACCURACY are features of the Hartford Milling Vise which incorporates dual handle, one hand operation, and a heat-treated steel movable jaw. It is fashioned to obtain absolute alignment without danger of distortion. Request additional data about this Hartford Milling Vise and Bulletin V-100 from the HARTFORD SPECIAL MACHINERY CO., Dept. 5-75, Hartford, Conn., or use INFORM-A-GRAM Key No. 575-R.

A NEW RUBBER TYPE PRINTING METHOD which enables one to use different faces and sizes of type in the same line with perfect alignment is being made by the WM. A. FORCE CO., 216 Nichols Ave., Brooklyn 8, N. Y. Both the type and the base are cast from rubber in one piece with corresponding grooves which are easily locked together by finger pressure. Write for more information to the manufacturer, Dept. 2-93, or use INFORM-A-GRAM Key No. 293-R.

TAPERS ARE TURNED FASTER, MORE ACCURATELY, with the Monarch Anti-Friction Bearing Taper Attachment, which takes heavier cuts than any other attachment. Its many advantages add up to substantial cost reduction. Further information is contained in Bulletin 1955-A from THE MONARCH MACHINE TOOL COMPANY, Dept. 5-38, Sidney, Ohio, or use INFORM-A-GRAM Key No. 538-R.

MAKING IT POSSIBLE TO COMPLETE A SERIES of operations without removing the work from alignment, Procunier Quick Change Chucks and Collets only necessitate raising the closing collar to release the collet without slowing the machine. Read more about these time-saving tools in a new 2-color brochure recently announced by the PROCUNIER SAFETY CHUCK CO., Dept. 6-23, 18 So. Clinton St., Chicago 6, Ill., or use INFORM-A-GRAM Key No. 623-R.

A COMPLETE METAL-MARKING UNIT, including steel type as required and a patented wedge grip single holding tool that can hold as many as nine sizes of type, is described and illustrated in a new bulletin published by the M. E. Cunningham Co. This "Utility" outfit can be used for all interchangeable metal-marking purposes. Write to M. E. CUNNINGHAM CO., Dept. 1-70, 104 E. Carson St., Pittsburgh, Pa., for this factual bulletin, or use INFORM-A-GRAM Key No. 170-R.

HOW AIR POWER TAKES OVER THE WORK of the devices manufactured by Mead Specialties Co. is discussed in a vividly illustrated 32-page booklet just off the press. Included are the main features and duties of Mead air presses, vises, clamps, collets, valves, and feeders, plus instructive setup data and blueprints. A loose-leaf price list is enclosed. Write to MEAD SPECIALTIES CO., Dept. 5-69, 4114 N. Knox Ave., Chicago 41, Ill., or use INFORM-A-GRAM Key No. 569-R.

SHOWING IN ACTUAL PHOTOGRAPHS THE MANY PROCESSES to which the Masterform cutting tools are subjected, Masterform literature now available gives in detail the job ability of Masterform tools, tool descriptions, and an accompanying price list. Get this booklet from the MASTERFORM TOOL CO., Dept. 9-46, 2532 Irving Park Road, Chicago 18, Ill., or use INFORM-A-GRAM Key No. 946-R.

MOVING PARTS OR CHANGING BUSHINGS IS NOT NECESSARY when drilling, tapping, counterboring, chamfering, or inspecting with the compact Lift-Swing Fixture. This fixture permits parts to be accurately loaded and unloaded from the top. The top plate can be lifted and swung for inspection while in location. Write for a descriptive folder to LIFT-SWING FIXTURE CORP., Dept. 84, 237 South Ave., Garwood, N. J., or use INFORM-A-GRAM Key No. J84-R.

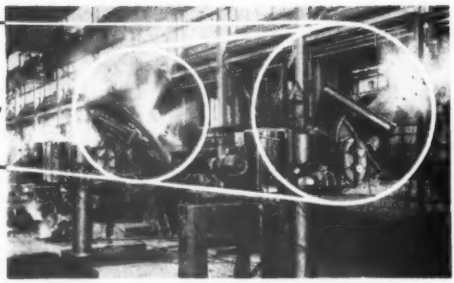
TAKING THE MAGNETIZING CURRENT OFF A POWER LINE, the Power Factor Regulator raises the power factor and renders more power in relation to the cost of current, by employing the Haug System of control. Having no moving parts, the Power Factor Regulator requires little maintenance and eliminates troublesome circuit conditions. Literature giving clear, well-illustrated explanations of the system is available from the MODERN CONTROL EQUIPMENT CO., Dept. 29, 176 W. Adams St., Chicago 3, Ill., or use INFORM-A-GRAM Key No. H29-R.

EXTREME RIGIDITY AND SPEED ARE FEATURED by the "Tru-Bore" lathe boring tool which offers added strength in boring, versatility of operation, and superior material and design. "Tru-Bore" attains special rigidity by using the entire compound rest and accurately finished round halves for the support of the boring bar. A folder discussing and showing various operative positions of the "Tru-Bore" is available from the OLIVER MOTORCRAFT CORP., Dept. 79, 2532 S. Wabash Ave., Chicago 16, Ill., or use INFORM-A-GRAM Key No. J79-R.

TWO DESIGNS OF HYDRAULIC BORING MACHINES set up to suit various needs are clearly illustrated and discussed in new literature now available from the Hydro-Borer Co. Actual photographs citing dimensions and parts show basic and specially equipped units on six pages of loose-leaf catalog material. This literature is now available upon request from THE HYDRO-BORER CO., Dept. 81, 214 W. Orange Grove Ave., Burbank, Calif., or use INFORM-A-GRAM Key No. J81-R.

A COMPLETE DESCRIPTION AND ACTUAL PHOTOGRAPH of each of 24 styles of the Ferracute Press line make up the very complete brochure, "Ferracute Presses for Profitable Production," now available. Press manu-

More WELDING going on here.....



More welding and less time spent in flopping, propping up and crawling around weldments is the end result of the C-F Positioners in this welding department. Mounted on C-F Welding Positioners, weldments can be quickly brought into position for a downhand pass — better, more uniform welds with resulting economies and production increases follow. Weldors spend more time welding when they work with C-F Positioners because one "set-up" on the table allows them to maneuver the job without assistance, whether hand or power operated Positioners are used. Power operated, variable speed C-F Positioners, with table rotation speeds in any range from 0 RPM and up, coupled with table tilt to 135° from the horizontal make them the logical choice for any production welding operation. Like all C-F Positioners, they have drilled tables for easy set-ups or tables can be quickly removed for installation of special fixtures or jigs. Write for Bulletin WP 22. CULLEN-FRIESTEDT CO., 1316 S. Kilbourn Ave., Chicago 23, Ill.

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facturers for over eighty years, Ferracute offers consultation on individual production problems. Send for this new literature to FERRACUTE MACHINE CO., Dept. 77, Bridgeton, N. J., or use INFORM-A-GRAM Key No. J77-R.

A WIDE VARIETY OF ROTATING ELECTRIC MOTORS, DYNAMOTORS and converters meeting many job requirements are illustrated and their construction and performance discussed in the recently published catalog of the ELECTRIC SPECIALTY CO., Dept. 78, Stamford, Conn. This literature also includes an historical outline of ESCO manufacturing methods and accomplishments. Write to the above address for their catalog, No. 46-1, or use INFORM-A-GRAM Key No. J78-R.

A PERFECT ALL-AROUND TOOL FOR CUTTING OFF PIPE, TUBING, conduit and small bars of ferrous and non-ferrous metals, the Machine-Craft portable metal cutting saw will cut flush and square to any wall or surface. Weighing only 14 pounds, it may be used also as a bench tool. Illustration and literature are available upon request from MACHINE-CRAFT MFG. CO., Dept. 74, 3805 Avalon Blvd., Los Angeles 11, Calif., or use INFORM-A-GRAM Key No. J74-R.

PROVIDING FRICTION-FREE TURNING, Jergens Anti-Friction Pilot Bushings are set on Precision Roller Bearings. Mounted either in fixtures, chucks, or directly in the spindle, these bushings allow heavier cuts and contribute to accuracy, endurance, and economy. Send for descriptive material from JERGENS TOOL SPECIALTY CO., Dept. 18, 712 E. 163rd St., Cleveland 10, Ohio, or use INFORM-A-GRAM Key No. J18-R.

WITH A PRESSURE RANGE FROM "DELICATE" to two and a half tons, the Air Hydraulic Press does countless operations on metals, plastics, ceramics, and leather. It has a uniform stroke which delivers ram pressures 50 times the air intake pressure. No shock or racking noise accompanies operation which is by hand or foot operated valve or push button controlled solenoid valve. Write for the new explanatory catalog from AIR-HYDRAULICS, INC., Dept. 51, 120 W. Middle St., Chelsea, Mich., or use INFORM-A-GRAM Key No. J51-R.

MANUFACTURING METHODS ARE ADVANCED AND COSTS REDUCED with strictly interchangeable "Standard" Steel Die Sets. Re-work and fitting is unnecessary in replacing die shoes and punch holders; sets are fitted with high quality, gaged guide pins. STANDARD MACHINERY CO., Dept. 30, Providence 7, R. I., will send Catalog Section DS, or use INFORM-A-GRAM Key No. F30-R.

AUTOMATICALLY COUNTING FINISHED PIECES AS IT GUARDS, the Searjeant "Counting Guard" marks a simple yet distinct improvement in mechanical safeguards. Easily installed and adjusted, the Counting Guard is based on the sweep action of an adjustable guard arm which works with each downward stroke of the ram. Get the illustrated folder about this device from the W. H. SEARJEANT CO., Dept. 14, 89 Allen St., Rochester 6, N. Y., or use INFORM-A-GRAM Key No. G14-R.

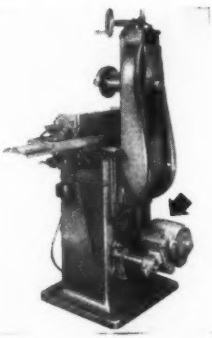
TWO NEW "TIMESAVER" MACHINES ARE DISCUSSED in a recent brochure: the marking machine is for use on round stock; has easily changed individual letters. Low cost and a full guarantee are offered with the Timesaver Hand Tapper which is designed for small run tapping and reaming production. Write for the Timesaver folder explaining these machines from TIMESAVER TOOL CO., Dept. 80, 3128 S. Main St., Los Angeles 7, Calif., or use INFORM-A-GRAM Key No. J80-R. Re-work and fitting is unnecessary in replacing INFORM-A-GRAM Key No. F30-R.

SUITABLE TO ANY, ALL, OR A COMBINATION of machine movements, the "Hy-Mac" Hydraulic Power Units are easily adapted to machine conversions, riveting and piercing, broaching, grinding, welding, and presses. After needs are determined, trained hydraulics engineers skillfully recommend a power unit and layout of the circuits to best do the job. A ten-page booklet discussing the units is available from HYDRAULIC MACHINERY, INC., Dept. 32, 12825 Ford Rd., Dearborn, Mich., or use INFORM-A-GRAM Key No. 32-R.

GIVING LARGE CAPACITY AT LITTLE COST, the Delta-Milwaukee Coolant Pump and Tank is adaptable and adjustable to most wet machine tools. A portable unit with 16 gallon capacity, it is self-contained, and of simple construction. Literature is available from the DELTA MFG. DIVISION OF ROCKWELL MFG. CO., Dept. 51, 600 E. Vienna Ave., Milwaukee, Wis., or use INFORM-A-GRAM Key No. 51-R.

ENJOYING THE ADVANTAGES OF FASTER CUTTING SPEEDS and longer tool life of carbides, Ford Standard and Miniature Solid Carbide Burrs are precision ground by experts and can serve in many instances in place of hand-filing and grinding operations. Photographs showing actual sizes, styles, and cut of these burrs, plus price lists, are in the new literature now available from M. A. FORD MFG. CO., INC., Dept. 42, 732 W. First St., Davenport, Iowa, or use INFORM-A-GRAM Key No. A42-R.

THE COST REDUCING ADVANTAGES tool and die makers get from the new air-hardening die steel recently invented by The Carpenter Steel Co. will be demonstrated during the National Metal Congress and Exposition in Atlantic City. Advantages of this new steel are low temperature heat treatment, uniform hardening in heavy sections, and minimum distortion and size change. Detailed informa-



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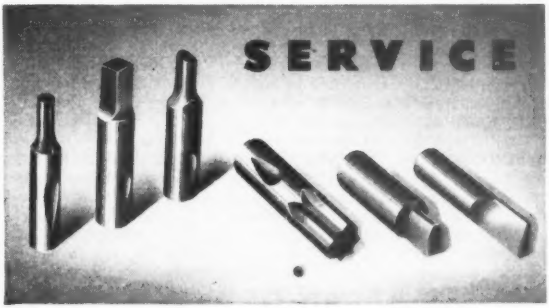

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Allied's R-B Interchangeable Punches and Dies for the metal-working and plastics industries are *available from stock* in standard round, oblong and square shapes of almost any required size. Special shapes, such as those illustrated, are *promptly furnished* to your specifications in any size or material. Full information and comprehensive R-B Catalog on request.

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tion on this new steel is available from THE CARPENTER STEEL CO., Dept. 38, Reading, Pa., or use INFORM-A-GRAM Key No. B38-R.

DISCUSSING THE MANUFACTURING METHODS OF SCHERR'S unique micrometer, which is now provided with a ten thousandth inch vernier, an eight-page illustrated booklet is available from the George Scherr Co. Their line of micrometers, formerly manufactured under the name of Reed, permit uniform accuracy, durability, easier reading, and a smooth "feel". Copy of this booklet may be had from the GEORGE SCHERR CO., Dept. 4-90, 200 Lafayette St., New York 12, N. Y., or use INFORM-A-GRAM Key No. 490-R.

ENABLING TWO TOOLS TO BE GROUND SIMULTANEOUSLY at the same or different angles, Willey's New Universal Angle Protractor provides a dual change of angles from 0° to 90°. A separate unit studded to the body of the adapter, this angle protractor meets the requirements for accurate, speedy grinding of carbide cutting tools, for use on carbide tool grinders, and lends itself to a variety of other machine operations. Get additional literature from WILLEY'S CARBIDE TOOL CO., Dept. 5-51, 1340 W. Vernor Highway, Detroit 1, Mich., or use INFORM-A-GRAM Key No. 551.5-R.

CONTAINING PHOTOGRAPHS, PRICE LISTS, and valuable engineering data, the new 28-page catalog now being distributed by the Nelco Tool Co., Inc., presents their line of Carboloy tipped shell mills, face mills, end mill cutters, half side mills, key seat cutters, solid Carboloy reamers, and other cutting tools. It is available upon request from NELCO TOOL CO., INC., Dept. 72, 370 Hamilton Ave., Brooklyn 31, N. Y., or use INFORM-A-GRAM Key No. E72-R.

FEATURING EXTENSIVE IMPROVEMENTS, the Cincinnati No. 2 Milling Machines are completely new. Especially advantageous for shops producing small and medium sized parts, the No. 2 MI has crank selection of sixteen spindle speed and feed rates, live rapid traverse, heavy overarm with built in vibration damper, plus many other interesting devices. Send for the 12-page, detailed booklet, Publication No. M-1429-1, from THE CINCINNATI MILLING MACHINE CO., Dept. 2-33, Cincinnati 9, Ohio, or use INFORM-A-GRAM Key No. 233-R.

VOLUME PRODUCTION OF SMALL SLENDER PARTS requiring extreme precision and fine finish is fulfilled with the Wickman No. 1 Swiss Type High Precision Automatic. Limits of a few ten-thousandths on diameter and concentricity are maintained. Specifications and data are available from THE WICKMAN CORP., Dept. 5-26, Detroit, Mich., or use INFORM-A-GRAM Key No. 526-R.

EXACTLY FITTED IN DESIGN AND WORKMANSHIP FOR THE JOB it is intended to do, the Continental Broach is ground to exceptionally close tolerances. A complete range of internal and external broaches, broach fixtures, holders and pullers, are available. Get in touch with CONTINENTAL TOOL WORKS, DIV. OF EX-CELL-O CORP., Dept. 7-37, Detroit 6, Mich., or use INFORM-A-GRAM Key No. 737-R.

RAPID CUTTING, HIGH LUSTER, HEAT RESISTANCE AND LONG LIFE are obtained by DME Abrasive Cloth Bench Rolls, Mold Polishing Compound and Abrasive Powder for polishing molds and general lapping work. The three are indispensable companion supplies for mold makers; details are available from DETROIT MOLD ENGINEERING CO., Dept. 2-64, 6686 E. McNichols Rd., Detroit 12, Mich., or use INFORM-A-GRAM Key No. 264-R.

SUPPLEMENTING THE USE OF WOVEN WIRE, Lektromesh, the one-piece solid metal screen, is stiff, strong, and cannot ravel. Most applicable in the finer sizes beyond the limits of perforated metal, Lektromesh hole diameters are extremely accurate and vary from 40 to 400 mesh. Further details about Lektromesh, including samples, will be sent from the C. O. JELLIFF MFG. CORP., Dept. 8-61, Southport, Conn., or use INFORM-A-GRAM Key No. 861-R.

TANNED AND IMPREGNATED TO WITHSTAND A WIDE RANGE of temperatures, mediums, and pressures, Alexander Leather Packings come in four standard types carefully fitted to production needs. With consideration for the variance in industrial conditions, a well-illustrated and fact-packed booklet is available to help with packing selection from ALEXANDER BROS., Dept. 76, 406 N. Third St., Philadelphia 23, Pa., or use INFORM-A-GRAM Key No. F76-R.

IDENTICAL WELDING CHARACTERISTICS ARE ATTAINED at all heats with the Larkin Welder. Constructed of high grade die-stamped silicon steel sheet, it employs four oversize coils of copper with mica, spun glass and asbestos insulation. Constant voltage is assured by the Amperage Glide Control. All styles and sizes of Larkin Welders are described in detail in a loose-leaf folder now available from LARKIN LECTRO PRODUCTS CO., Dept. 87, New York 30, N. Y., or use INFORM-A-GRAM Key No. J87-R.

ON THE SPOT COLD BENDING IS POSSIBLE with the Portable Hydraulic Pipe Bender which gives the machinist complete visibility during the operation without removing the pipe from the die. Suitable for a large variety of bends, this unit provides a special die for each size. Write for the new well-illustrated Bulletin, WS-No. 4-7, available from WATSON-STILLMAN, DISTRIBUTOR PRODUCTS DIV., Dept. 44, Roselle, N. J., or use INFORM-A-GRAM Key No. B44-R.

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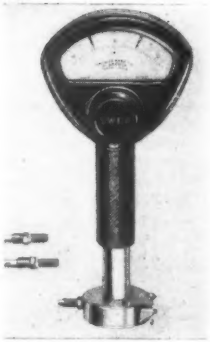
The Mikro-Internal Indicator is a new assembly. The gage itself is an application of the Mikrokator frictionless amplification applied to the standard line of Internal Indicators.

The dial is graduated in .0001" with a scale range of .006" and for closer tolerances can be had with a scale range of .0024" graduated in .00005". These scale ranges and graduations can be had in diameter ranges of 13/16 to 6" with a standard measuring depth of 4".

It is rapid, reliable, sensitive, light, compact with positive repeat readings. It is an ideal instrument for checking internal diameters in size, out of round and taper, both in the shop and in the inspection department.



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PUBLICATION PREVIEWS

COMBINING PRECISION AND VERSATILITY. Nichols Millers can be put to work in the toolroom or laboratory for high speed semi-automatic jobs, second operation milling, boring or facing, or for special applications. An exclusive lever, rack and transverse feed is a Nichols development which gives saddle and table the flexibility of lathe carriage and cross-slide to their hand feed millers. Descriptive literature may be secured from NICHOLS-MORRIS CORP., Dept. 943, 50 Church St., New York 7, N. Y., or use INFORM-A-GRAM Key No. 943-R.

ABSOLUTELY CONTROLLING PITCH DIAMETER. lead and angle, Republic Ring and Plug Thread Gages are electrically hardened to eliminate all distortion or strain. Relieved major diameters which permit the maximum number of resets and reworks at minimum cost, a special dust groove, and lapped threads are other features of the Republic Gage. Write for further details to REPUBLIC GAGE CO., Dept. 923, 2228 Fenkell Ave., Detroit 21, Mich., or use INFORM-A-GRAM Key No. 923-R.

COMPLETELY ELIMINATING FRICTION, LAG, AND BACKLASH, the Mikrokator insures positive and dependable repeat reading. Utilizing 100 percent mechanical amplification, this instrument gets instant response without vibration to the true reading point. Explanatory material covering the construction and usage of the Mikrokator and available attachments will be sent upon request from the SWEDISH GAGE CO. OF AMERICA, Dept. 85, 8900 Alpine Ave., Detroit 4, Mich., or use INFORM-A-GRAM Key No. B85-R.

MEASURING THE HARDNESS OF METALS with either the recording or direct reading portable Scleroscope is explained in Bulletins S-22, S-30, and S-32 published by the Shore Instrument and Mfg. Co. These instruments have incorporated an equivalent standard Brinell scale, which facilitates the testing of large jobs too heavy to be moved. Copies of these bulletins will be sent on request from THE SHORE INSTRUMENT AND MFG. CO., INC., Dept. 126, Jamaica, N. Y., or use INFORM-A-GRAM Key No. 126-R.

CUTTING QUICKLY AND ECONOMICALLY all types of rods, tubes, angles, heavy rounds or flats and irregular shapes, the Johnson Metal Cutting Bandsaw (dry cutting model) gives smooth, quiet cut results. Easily doing work that would tax much more expensive machines, this bandsaw requires only one or two minutes for setup, thereafter handling itself. Write for descriptive literature to JOHNSON MANUFACTURING CORP., Dept. 648, Sales Office, 5000-4 Chrysler Bldg., New York, N. Y., or use INFORM-A-GRAM Key No. 648-R.

PROVIDING A BUILT IN "SHOCK ABSORBER" for cutting strains and shocks, "Cushioned" Carbide Tipped Tools feature tips with copper shim cushions on the bottom surfaces. This cushion overcomes the weakness of tensile strength and elasticity of carbide, and consequently delays the breaking down of the cutting edge. Get the illustrated Catalog No. 502 and price list covering these tools by writing to GENERAL TOOL & DIE CO., INC., Dept. 36, 555 Prospect St., East Orange, N. J., or use INFORM-A-GRAM Key No. G36-R.

CENTERLESS GRINDING PARTS UP TO 1" DIAMETER while maintaining a 10 micro finish or better is possible with the new bench model centerless grinder recently announced by the Morrow Engineering Co. Embodying an angular and profile dresser, this compact unit is easily adjusted and operated. An illustrated leaflet, including specifications and a 2-view diagram, will be sent upon request by MORROW ENGINEERING CO., Dept. 88, 1132 E. Firestone Blvd., Los Angeles 1, Calif., or use INFORM-A-GRAM Key No. J88-R.

GIVING ABSOLUTE PRECISION ON SHORT OR LONG RUNS for practically any type press, Whistler Adjustable Perforating Dies are interchangeable and of simple design for easy manipulation. With a background of 26 years experience, S. B. Whistler & Sons discusses these dies with die assemblies, punches, and bushings in their new catalog No. 44. Containing diagrammatic views and price lists, this 24-page study is available upon request from the manufacturer, S. B. WHISTLER & SONS, INC., Dept. 88, Buffalo 17, N. Y., or use INFORM-A-GRAM Key No. 88-R.

HOLDING WORKPIECES of regular or irregular shape for compound angular drilling, milling, grinding, turning, and boring is accomplished by the Collins Co. Axial Work Holder. Settings are made without the use of sine bars, gages, jacks, blocks or wedges, but through a graduated ball and collar. The holder has a full movement through 360° and can be positively locked in any position required. Angular uses for these work holders are only limited by the user's imagination. For complete details and specifications, write COLLINS INDUSTRIES, INC., Dept. 92, Bryan, Ohio, or use INFORM-A-GRAM Key No. J92-R.

VARYING DRILL PRESS SPEEDS by convenient, quick shifting is desirable on drill presses equipped with multiple spindle turrets. Literature describing the Era Variable Speed Drive attachment also gives the speed ranges obtainable on various makes of drill presses when equipped with this attachment. Copies of this literature will be sent on request from ERA METER CO., Dept. 11, 3940 N. Kilpatrick Ave., Chicago, Ill., or use INFORM-A-GRAM Key No. F11-R.

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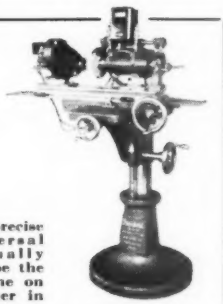

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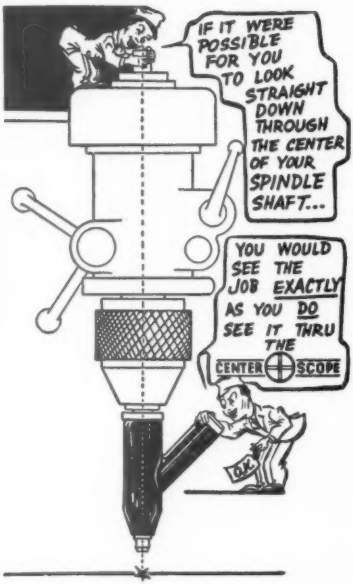
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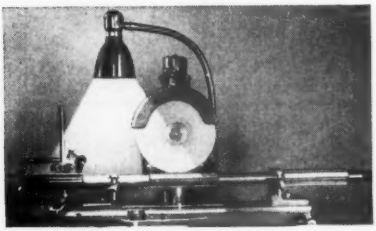

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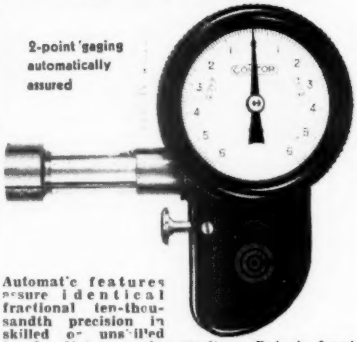

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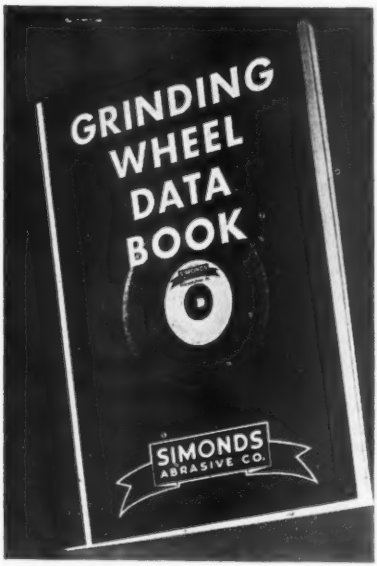

from Advertising Dept., Simonds Abrasive Company, Dept. 1-72, Tacony and Fraley Sts., Philadelphia 37, Pa., or use INFORM-A-GRAM Key No. 172-R.

A ROD SELECTOR CHART on Eutectic low temperature welding rods, for use with Oxy-Acetylene—metal (ac-dc), furnace, carbon arc, and induction heating, gives properties of welds and procedure information. High strength, matching color, and less stresses, warping and preheating, are advantages of welding with EutecRods (gas), and Eutec-Trodes (arc). All rods are listed in standard sizes, with work and metals on which to be used. A copy is available from Eutectic Welding Alloys Corporation, Dept. 81, 40 Worth St., New York 12, N. Y., or use INFORM-A-GRAM Key No. 81-R.

NEW INFORMATION covering technical phases of the sodium hydride descaling process, together with suggested types of equipment for use with this process, is given in new literature by Holden. This information is an asset to companies having problems in metal cleaning and descaling. It would be to their advantage to investigate the process and equipment. Readers who are now using acid for pickling or sand blasting, will also be interested in this booklet. It is available upon request from The A. F. Holden Company, Dept. 1-50, New Haven 8, Conn., or use INFORM-A-GRAM Key No. 150-R.

"CHARACTERISTICS OF KENNAMETAL" presents information gathered together and offered on cemented carbides. The high degree of hardness, strength, and resistance to wear, of Kennametal compositions are well known to tool users. Not so well known, or more recently determined, are many distinctive characteristics, some of which are exemplified to a high degree by Kennametal compositions. In the latter products such valuable properties are available in the desired combinations. The booklet describes the general nature of Kennametal compositions, and brings together information as to their properties. Copies may be secured from Kennametal Inc., Dept. 33, Latrobe, Pa., or use INFORM-A-GRAM Key No. 33-R.

WEAR, HEAT AND CORROSION resisting alloys available in castings, rolled forms, welding rods, and metal-cutting tools are described in a new booklet, "Haynes Alloys".

A chart describes a number of these alloys and their significant properties; available forms of these useful materials are discussed; and literature about the alloys is listed at the end of each of the descriptions. The company has had broad experience in producing alloys by the investment method, including making of millions of turbine buckets for aircraft turbosuperchargers, and all types of small machine parts such as gages, blades, nozzles, bushings, sleeves and valves. Request your copy from Haynes Stellite Co., Unit of Union Carbide and Carbon Corp., Dept. 64, Kokomo, Ind., or use INFORM-A-GRAM Key No. C64-R.

WHAT ARE THE IMPORTANT FACTORS to consider in buying diamond tools? Which diamond tool prevents injurious overheating of the diamond? What diamond tool minimizes

resetting? What device prevents wasteful overwork of diamonds? These questions are answered in a new catalog just issued by J. K. Smit & Sons, Inc. Very helpful information plus pictures of the use of diamond tools for boring, turning, roughing, semi-finishing, and form dressing will also be found in this publication. Request a copy on your letterhead addressed to J. K. Smit & Sons, Inc., Dept. DT, 157 Chambers St., New York 7, N. Y., or use INFORM-A-GRAM Key No. 48-R.

"TOOL STEEL FOR THE NON-METALLURGIST" presents, in a pocket-size booklet, a series of articles explaining characteristics of different types of oil hardening and air hardening tool steels and high speed steels; outlining purposes for which each is best adapted; and suggestions for heat treatment of the four basic types of tool steels. Quenching and tempering of tool steels; a few paragraphs on grinding; a hardness conversion table; and useful mathematical rules are in the back of this book, particularly compiled for the shop man. Request your copy from Crucible Steel Company of America, Dept. 2-56, Chrysler Bldg., 405 Lexington Ave., New York 17, N. Y., or use INFORM-A-GRAM Key No. 256-R.

FACTS CONCERNING COOLANTS, SPEEDS AND FEEDS for turning, facing, boring, and milling steel, cast iron, non-ferrous, and non-metallic materials are clearly given in the new catalog of the Vascoloy Ramet Corp. Almost as comprehensive as a text book, this technical carbide manual features tables giving angles for turning tools and milling cutters and recommends thickness of tool tips and machinability ratings for various materials. There are ten full pages of tool engineering information plus illustrated lists of nearly 500 standard carbide tools and blanks. Copies of this booklet are available from Vascoloy Ramet Corp., Dept. 25, N. Chicago, Ill., or use INFORM-A-GRAM Key No. 25-R.

APPLICATION OF "DAG" COLLOIDAL GRAPHITE in all liquid carriers is shown by related dispersion charts for water, oil, volatile hydrocarbons, alcohol and special solutions, with photographs giving the complete story of colloidal graphite's versatility and usefulness in the new 16-page, 3-color "dag" technical booklet. Including interpretations of the 19 fundamental properties of colloidal graphite, with reference and indexing to 23 pieces of specialized technical literature, this catalog is free upon request from Acheson Colloids Corp., Dept. 45, Port Huron, Mich., or use INFORM-A-GRAM Key No. A45-R.

ADVANTAGES AND ECONOMIES OF OAKITE SOLUBLE OIL in machining, cutting, and grinding on ferrous and non-ferrous metals are discussed with reference to war experience and current use in hundreds of plants in a 20-page manual just issued by Oakite Products, Inc. Several pages are given to starting point formulae for coolant emulsions and a full section covers the correct mixing procedures for coolants so as to avoid inverted emulsions. This helpful information is available upon request from Oakite Products, Inc., Dept. 1-21, 57 Thames Ave., New York 6, N. Y., or use INFORM-A-GRAM Key No. 121-R.

FIGURES, DATA AND OTHER INFORMATION designed to assist the estimator, set-up man and operator in employing production tapping to the best advantage are found in "Production Tapping Guide" recently published by The Cleveland Tapping Machine Co. Suggested approximate efficient maximum and minimum tapping surface speeds for non-ferrous materials, cast metals, steel, and plastics are given in table form, accompanied by tables converting tapping surface speeds to spindle rpm. Suggested lubricants and coolants for production tapping these same materials are also tabulated. Suggested corrections of troubles encountered in tapping and drilling are included. Copies of this tapping guide can be obtained on request from The Cleveland Tapping Machine Co., Dept. 242, Hartville, Ohio, or use INFORM-A-GRAM Key No. 242-R.

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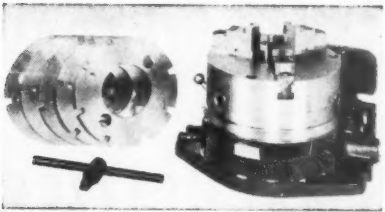

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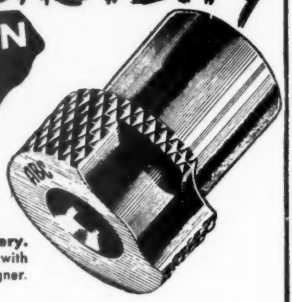

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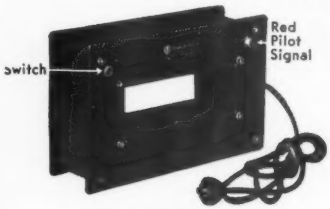

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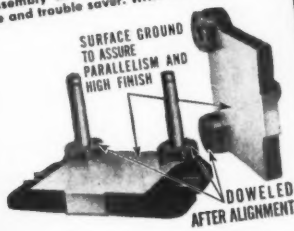

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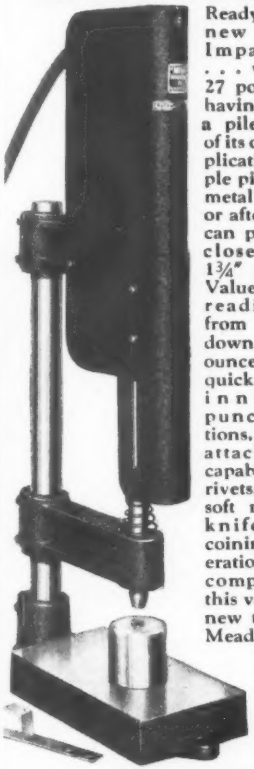

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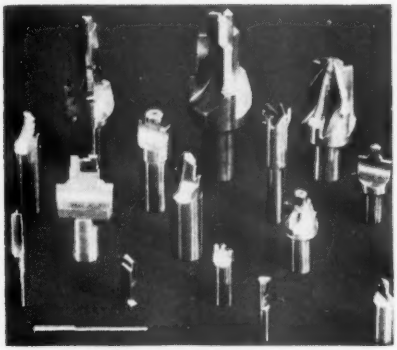

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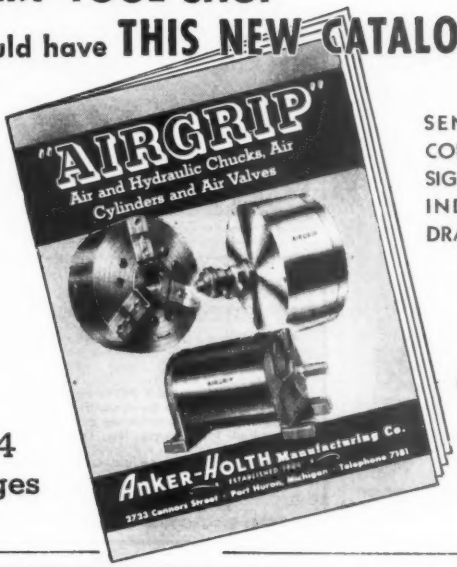
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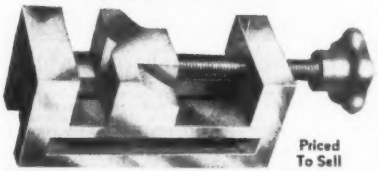

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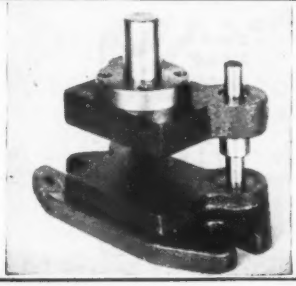

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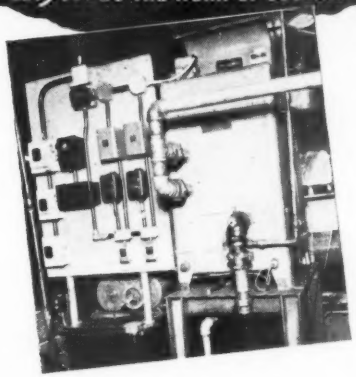

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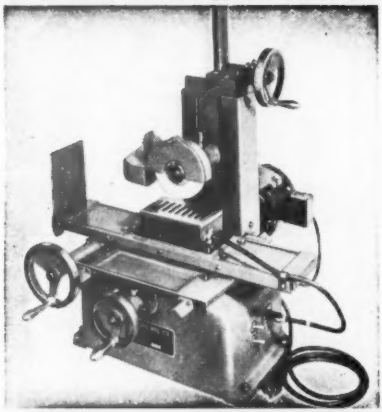

High-Speed BENCH SURFACE GRINDER

ACCURATE WITHIN .0001

A sensitive machine built to rigid standards of accuracy and workmanship specially designed *"For the job that fits in your palm."*

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SANFORD MFG. CO.
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DRIVE ALL
TRADE MARK REG U.S. PAT. OFFICE

System Of Individual Motor Drives

for all kinds of machines and equipment requiring one or many speeds.

1 Speed
3 Speed
4 Speed
} Models

- Complete units for Brown & Sharpe, Cleveland and other automatics.
- 3- and 4-speed DRIVE-ALL Gear Transmissions provide a selective change of speeds through finger-tip control.
- Single speed transmissions, for machines running at a constant speed, provide better use of higher speed motors through larger driving pulleys, such as are required for efficient punch press operations.

COMPLETE INFORMATION FURNISHED UPON REQUEST

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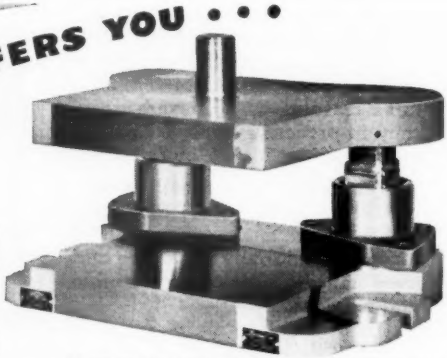
NOW EVANS OFFERS YOU • • •

NEW SPEED and ACCURACY WITH MICROLEX ANTI-FRICTION DIE SETS • • •



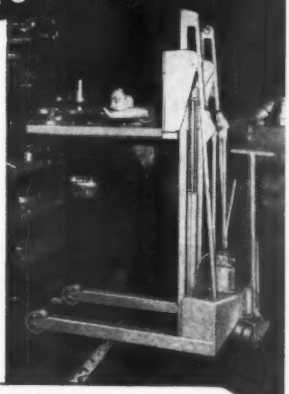
MICROLEX

Microlex Die Sets have ball or roller bearing guide pins which reduce die setter's time . . . enable you to get into production quicker . . . permit fast press speeds. Microlex Die Sets eliminate all down time caused by bound, scored or galled pins. Bearings have pre-load of .0015" to prevent play between guide pins and bushings.

You don't have to wait to cash in on the profitable advantages offered by Microlex Die Sets. A large number of sizes are ready for immediate shipment.

EVANS REAMER AND MACHINE CO.
529 S. Main Street • New Lexington, Ohio

REACH HIGH AND LOW RACKS
with a
LYON-Raymond
Hydraulic
HIGH-LIFT TRUCK



One man easily places a heavy die in a high storage rack with a Lyon-Raymond High-Lift Truck.

Ease! Convenience! Safety! All three qualifications of efficient material handling are provided by this maneuverable, versatile Lyon-Raymond truck with . . .

- Hydraulic operation
- Fingertip lowering control
- Short turning radius, turns in own length
- 360° turning and operating radius
- Welded tubular and formed plate construction
- Timken Bearings in all wheels

Write for latest literature on this work-saving equipment.

LYON-Raymond CORPORATION
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2 SPEEDS

Meet Varied Needs

The Milwaukee Die Filer is designed to operate at two pre-determined speeds . . . 325 or 425 strokes per minute . . . stroke length 1½". The higher speed is exactly right for the free cutting steels, aluminum, other light metals, and plastics!

The slower speed assures maximum cutting efficiency and long tool life on hard alloy steels.

QUICK SHIFT: Speeds are easily and quickly changed by shifting V-belt notches on both pulleys. Proper tension is maintained on both sets of pulleys without shifting motor.

Write for Illustrated Bulletin

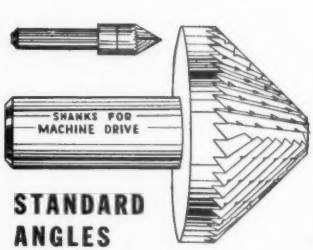
New Safety Guard

One-piece, all-metal guard now available to all owners and purchasers of the Milwaukee Die Filer. Easily installed, it gives the operator complete protection, yet does not interfere with speedy shifting of drive belt.

Milwaukee
CHAPLET & MANUFACTURING CO.
1029 S. 40th ST., MILWAUKEE 4, WIS.

A 5091-½

INSIDE DEBURRING CUTTERS



STANDARD ANGLES
30° - 45°
STOCKED IN 8 SIZES
EACH ANGLE

SPECIAL ANGLES
FROM STOCK BLANKS

HIGH SPEED STEEL

HANDLES
FOR
HAND USE
(4 THREAD SIZES)

RADIUS TYPE
10 SIZES

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Interchangable Motor Mount

- a feature of the **KALAMAZOO**

You can't afford to risk production losses on cut-off work by motor failure.

The Kalamazoo uses no special motor housings or end bells, but has a motor mounting that permits the use of any standard type motor.

Kalamazoo engineers designed this feature into this machine so there would be no headaches due to temporary motor repairs. You merely substitute any motor available and production speeds merrily along.

Ask your dealer or write direct for complete information.

MACHINE TOOL DIVISION
KALAMAZOO TANK & SILO CO., Kalamazoo 16, Mich.
In Canada — BRIDGE MACHINERY CO., Montreal

Kalamazoo *Metal Cutting* Band Saw

No Leaks No Levers No Packing

Air-O-cheks have the ball and socket joining the enclosed lever to the valve.

Note double grip afforded by long, extra heavy ferrules machine-formed over special shoulder on shank.

Comparison quickly demonstrates such Air-O-chek advantages as leak-proof operation, ease of use, dependability and time saving.

That's why four out of five plants adopt Air-O-chek Air Guns as standard after a comprehensive test.

Try it. Install a dozen Air-O-cheks and compare results with the best you ever had.

Prompt delivery on high priority. Sizes for all requirements. Catalog on request.

Made of Bar Brass and Stainless Steel

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has been done with the
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since 1907

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The COLOR tells the THICKNESS

ARTUS ARBOR SPACERS U. S. PAT.

ARTUS Arbor Spacers made of plastic in various colors identify thickness at a glance! .001, .0015, .002, .003, .005, .0075, .010—.030. Speed up accurate fitting at low cost. Write for folder.

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CUT ANY SHAPE CLEVERLY with a BEVERLY SHEAR

Regardless the shearing job, straight or irregular, you can do it faster—better with a BEVERLY Throatless Bench Type Shear. Comes in 3 sizes . . .

No. B1—cuts 14 gage—weight 18 lbs.

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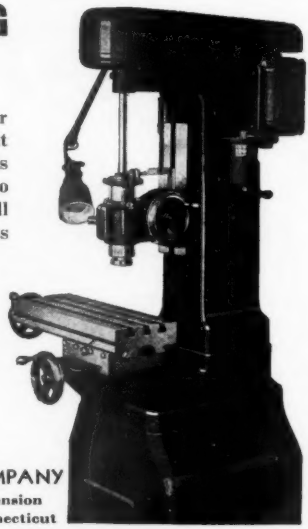
No. B3—(Equipped with ball-bearing holddown device)—cuts 3/16 inch mild steel or 10 gage stainless, weight 58 lbs.

The Beverly Shear Mfg. Co., 3004 W. 111th St., Chicago 43, Ill. Dept. 7

KEEP SMALL JOBS MOVING WITH A LINLEY



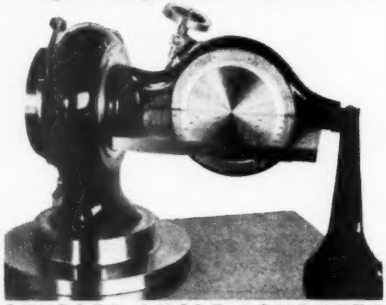
The Linley Miller and Jig Borer is designed for fast and accurate toolroom work. It is compact and easy to set up and operate. Changeover is rapid, with 8 velvet-smooth spindle speeds to 4250 r.p.m. for a wide variety of work on small dies, jigs, fixtures, patterns and models. Keeps larger machines on their higher rated capacities.

Other features include: grease-sealed bearings . . . carefully balanced parts . . . direct micrometer setting . . . anti-backlash in quill travel. Needs only 18½" x 20" floor space. Table top of 7" x 17½" is adequate.

Send for Bulletin.

LINLEY BROTHERS COMPANY
662 State St. Extension
Bridgeport 1, Connecticut

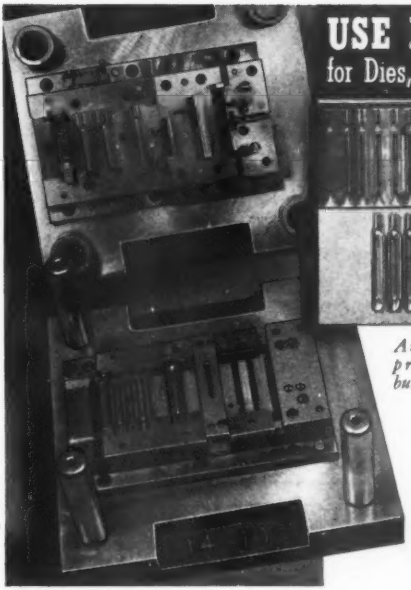
Compute Angles Quickly with the



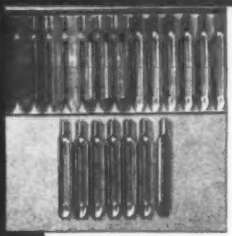
STUDLER ANGLE COMPUTER

● THE STUDLER ANGLE COMPUTER so simplifies layout of die work, survey of castings, and inspection of precision-machined parts that users report it is doing the work in one-half to one-tenth of the time required by other methods. With this instrument, only one set-up of the work is required since its surface plate may be rotated 360 degrees in each of three separate directions of rotation: horizontally, vertically, and radially. A part having a number of angles and related angles may be surveyed in a few MINUTES. Model "A", Surface Plate 9" x 4½" x ½". Model "G" (shown above) Surface Plate 16" x 9" x 1". Write today for Bulletins No. 2 and No. 5.

THE ANGLE COMPUTER COMPANY
1709 Standard Avenue GLENDALE 1, CALIF.



USE FEDERAL FACILITIES
for Dies, Special Tools, Jigs, Fixtures, Molds

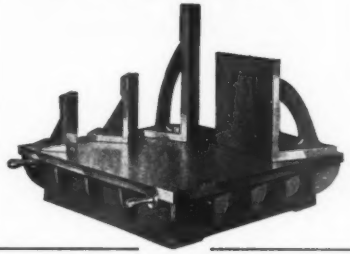


An eight-station progressive die built by FEDERAL.

- FEDERAL equipment is up-to-the minute.
- Our technique is modern—
- Our personnel is trained to meet your most exacting requirements.
- When you have a tooling problem, write FEDERAL.

FEDERAL TOOL CORPORATION
400 N. Leavitt Street
CHICAGO 12, ILLINOIS

MILWAUKEE
Surface Plates



A full line of surface plates, angles and box parallels. Standard plate sizes from 8″ x 8″ to 48″ x 96″, larger sizes with or without legs. Plates are finish-planed and scraped to insure a very accurate surface.

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TOOL HOLDERS and TOOLS

STANDARD WHEREVER METAL IS MACHINED

Over 96% of the machine shops and tool rooms use ARMSTRONG TOOL HOLDERS, because each is a permanent, multi-purpose tool that does the work of a complete set of forged tools. Each is a stronger, more efficient tool that takes cutter bits quickly ground from stock shapes of high speed steel, thus "Saves: All Forging, 70% Grinding and 90% High Speed Steel."

With the correct ARMSTRONG TOOL HOLDERS for each operation you will be permanently tooled-up for every operation on lathes, planers, slotters and shapers. They are sold by all leading industrial distributors.

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Armstrong Bros. Tool Co.
"The Tool Holder People"
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U. S. A.

NOW YOU CAN SEPARATE AND ASSEMBLE DIE SETS..QUICKLY..EASILY..SAFELY!

with a PERSSON

DIE JACK

These Die Jacks eliminate old-fashioned, unsafe, prying or hammering methods. Just clamp on punch holder and turn handle. Punch holder is raised or lowered smoothly, always under control. PERSSON Die Jacks are precision built from fine steel and alloys—a tool every tool maker will want for his tool box or bench drawer.

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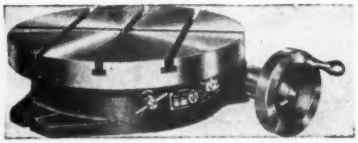

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OUR ROTARY TABLE WILL TAKE THE PLACE OF A COSTLY FIXTURE. IT IS USED FOR ALL KINDS OF WORK ON MILLING MACHINES, SHAPERS, DRILL PRESSES AND HORIZONTAL BORING MILLS.

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ALLOY STEELS

A century of experience in the development and application of special steels for PRODUCTION, TOOL ROOM, MAINTENANCE.

Seven warehouse stocks of rounds, flats, squares, hexagons, octagons. Forgings to specification.

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6 TIMES AS MANY THREADED HOLES *with*

REG. U.S. HY-PRO PAT. OFF.

TAPS

Excerpt from article in American Machinist —

"High-speed steel ground thread taps cost more than cut thread taps, but cost per tapped hole is much less, as when tapping at high speeds a ground thread tap will usually produce at least six times as many holes as a cut thread tap. It also requires less power. All conditions being equal, the ground thread tap requires about one-fifth the sharpening for the same number of tapped holes and is less easily broken."

PROMPT DELIVERY. Many special as well as standard taps in stock.

Commercial, Precision Special Ground Thread Taps

Send for catalog on Company Letterhead

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New Bedford, Mass., U.S.A.

BOYAR-SCHULTZ NO. 618 PRECISION SURFACE GRINDER

A MACHINE TOOL designed to give the fine finish and high degree of accuracy necessary in the finest gage grinding and tool and die making.

It is built with a sturdy ruggedness that maintains that fine accuracy for a long period of time . . . much longer than most similar tools are expected to last.

Such long lasting precision performance gives the inevitable result of greater economy.

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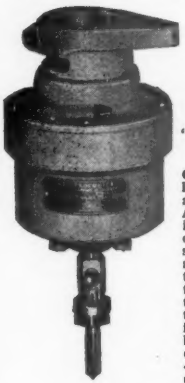
2112 WALNUT STREET • CHICAGO 12, ILL.

Sensitive Tapping Head for Fast, Accurate Tapping



"TRU-GRIP" TAP HOLDER

The new "Tru-Grip" is a smaller, lighter and more accurate tap holder. A broached section in the chuck receives the flattened surfaces on the spring collet, while the tap has a positive drive through the square hole in the collet. The tap is held in alignment by the round and driven by the square — taps are never scored.

★Cover clamping eliminates chatter

★Rigid mounting reduces vibration

The Procunier cover clamping tapping head clamps directly to the drill press quill for greater rigidity and freedom from chatter. Vibration and the tendency to "run-out" or "bell mouth" is minimized. Procunier Hi-Speed Tap Heads are precision built for accurate tapping at high speeds. Driven by a cork-faced friction clutch, the tap is protected by a soft "cushion" effect. Operators quickly detect the presence of a dull or "loaded" tap by the amount of pressure needed to drive the tap. The clutch instantly slips should the tap strike bottom or stick due to tap loading.

FAST, ACCURATE EXTERNAL THREADING WITH ACORN DIES

Do external threading jobs faster with a Procunier Tapping Head which holds standard Acorn dies. Cut external threads quickly in brass, die castings and aluminum.

PROCUNIER SAFETY CHUCK CO.

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12-14 S. Clinton St.
Chicago 3, Ill.

Send me bulletins on ( ) Procunier High Speed Tapping Heads ( ) Tru-Grip Tap Holders ( ) Universal Tapping Machines

Name .....

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City .....State .....

(CONTINUED FROM PAGE 109)

a filter be supplied in order that the system be kept as clean as possible. All of these valves are made with operating clearances of approximately .0003" to .001". Any amount of foreign material in the oil will, therefore, cause faulty operation. While we can recommend this provision for keeping our system clean, we have no control over the man who fits and installs the piping between all of these various valves. Since this is often the source of foreign material in the oil and the reason for faulty operation of the circuit, most of the ultimate users of hydraulic systems are continuously confronting us with the problem of combining as many of these functions into units as the economics of the system will permit.

Further, each pipe connected to our typical system and its fittings are a potential source of leakage. Here again, in order to minimize these sources of leakage, the consumers wish this combining of functions so that internal channels and cored passages will be substituted for piped connections.

(TO BE CONTINUED)

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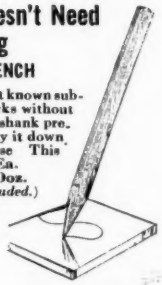
● WILL NOT ROLL OFF BENCH



CARBIDE tipped point (hardest known substance, next to diamond.) Marks without dulling. HEXAGONAL shaped shank prevents rolling away when you lay it down. Mechanics Everywhere Praise This 'Scriber. Single lots $1.25 Ea.
6 or more $12.00 Doz.
(*P.P and Sales Tax included.*)
Cash or company requisition.

GUILD PLATERS & MFRS.
Box 13, Highlands
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CLEVELAND INDEXING HEAD

Holds all Straight or Taper Shank Tools from 1/16" to and including 1 1/2" diameter

360° Graduations In Three Planes

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GRINDERS & FIXTURES, Inc.
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CRITERION *Boring Heads*

Original Accuracy *Maintained*

Noted for maintaining original accuracy over a longer period. Criterion Heads are smooth, compact, rigid. Parts subject to wear are hardened. Lead screw is hardened tool steel, with threads ground from solid after hardening. All heads have large, graduated dial. Large offset adjustment eliminates need for offset boring bars. Two sizes: 1⅛" and 3". ½" and 1" bar capacity. Shanks are interchangeable, enabling operator to use head on different machines. Ideally adapted for slide boring tool holder on small turret lathes. Ask your dealer or order direct. Request free literature.

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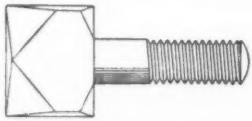
Lead Screw ground from solid AFTER hardening.

CRITERION MACHINE WORKS
BEVERLY HILLS, CALIFORNIA

New **NESTING TYPE TOTE PANS**

20" Long x 12" Wide x 6¼" Deep 16 Ga., drag holes, handles both ends.

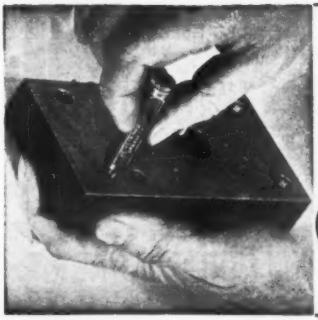
J. L. LUCAS & SON, INC.
BRIDGEPORT 5, CONN.



STEEL FORGED QUARTER TURN SCREWS FOR JIGS AND FIXTURES

Send for Catalogue "A"

INTER-STATE DESIGNING & TOOL CO.
3515 N. 10th St. Philadelphia 40, Penna.



A REAL HELPING HAND

It's a help that die makers, tool makers, machinery builders and general machinists have long sought—a more accurate and surprisingly faster way of transferring blind screw holes.

The Heimann Transfer Screw Set is a self-contained, complete tool. No wrenches or pliers are necessary. Made in 3/16" to 1" diameters.

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Urbana, Ohio

PROTECT PRECISION TOOLS

"Tool Coat"

(IMPROVED FORMULATION)

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= Positive Protection
= Ease and Speed of Application
= Substantial Money Savings
= Modern Packaging
= Assurance of Delivery in Good Condition
= Ease of Removal

"TOOL COAT" is a tough plastic with special rust inhibiting oils, high mechanical strength and resistance to shock and abrasion. Applied by dipping, it protects finely finished machine tools until the ultimate user peels off coating like a banana skin.

"TOOL KOTER" thermostatically controlled heating unit designed for proper melting of ethylcellulose and other thermoplastic compounds. Readily portable. Low wattage, all welded steel construction, heavy duty automatic thermostat, thoroughly insulated. Ready to operate including special heat transfer oil.

THE METHOD USED BY LEADING AUTOMOTIVE, AIRCRAFT, MACHINE TOOL MANUFACTURERS

Recommendations submitted without obligation.
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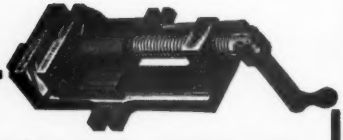

YOST DRILL PRESS VISE

This new Yost vise has been designed expressly for use on drill press operations. Does away with special and costly jig fixtures.

Offered in two sizes

Vise No.	Width of Jaw, Inches	Opens Inches	Weight Pounds
1D	3¼	4	12½
2D	6	5⅛	23

Do you need a vise of ANY type?

Write today for bulletins on the extensive Yost line

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MEADVILLE, PENNSYLVANIA

SANDER ▪ BELT SANDER ▪ BELT SANDER ▪ BELT SANDER ▪ BELT SANDER

Woods Model '40'
FOR METALS, WOOD, GLASS, PLASTICS AND RUBBER. CAN BE OPERATED IN HORIZONTAL OR VERTICAL POSITION.

SANDER COMPLETE WITH BELT AND WORK DAM $39.95

BALANCED PULLEYS TESTED TO 5000 RPM

A husky, ball-bearing sander and tool grinder, built for maximum efficiency, smooth operation and long life. 5" x 8½" work area, 36" belt. Reversible platen usable on either face. Dealer inquiries invited.

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DIAMOND IMPREGNATED

HONES

(Sintered Steel Bonded)

The life of carbide tools can be prolonged by lengthening the interval between regrinds. And this can be accomplished by touching up such tools lightly with FS Diamond Hones.

FS Diamond Hones are also recommended for shaping special contours on carbide form tools, where diamond grinding wheels do not suffice.

Hone is 6" long overall—diamond section being 1¼" x ½". For best results a 325-400 grit is recommended, and FS Diamond Hones are so stocked. Other grits from 100 to 600 also available.

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Fish-Schurman

A WHOLE SHOPFULL OF TOOLS IN ONE

Machinist-craftsmen find it unsurpassed for grinding, drilling, routing, carving, sanding, polishing and 9,994 other uses. Precision-engineered, AC-DC, with more exclusive features than any other tool.

Exclusive finger-grip brings hand closer for finer work

Complete with 35 accessories in fitted steel case

$22.50

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CASCO Electri-Craft Tool Kit

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NEOR

The Original Oil Hardening, Non-Deforming High Carbon-High Chrome Steel

Outstanding in its class! Your best steel for mass production dies. Possesses high resistance to abrasion, non-deforming, uniform hardness penetration to center of tool. Keeps a keen edge longer than most other tool steels. Ideal for slitting cutters.

FURNISHED IN BILLETS, BAR STOCK AND DRILL ROD.
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highest grade tool steels

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PRECISION COUNTERSINKING ..FASTER!

WITH THE AERO MICROMETER STOP COUNTERSINK

Here's What This Versatile, Dependable Tool Will Do For You:

ALL PURPOSE: countersinks and counterbores, both in metal and in plastics.

ACCURATE: accurately limits depth of cut, regardless of surface variations.

PREVENTS BUCKLING: eliminates buckling troubles in countersinking sheet metal.

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AUTOMATIC LOCKING: no accidental adjustment, absolute uniformity of cutting depth.

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Standard taper hole No. 50

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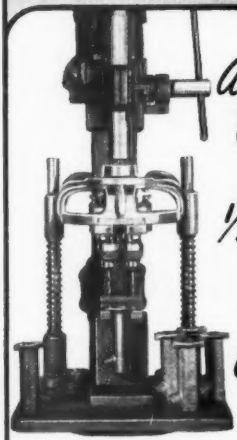

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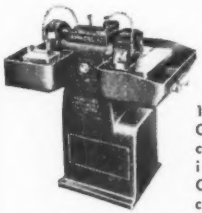

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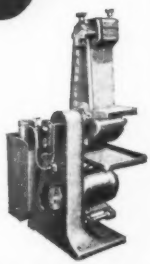

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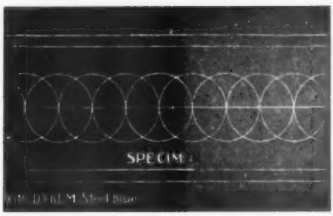

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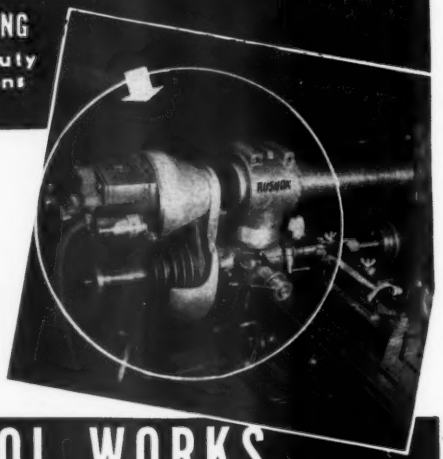

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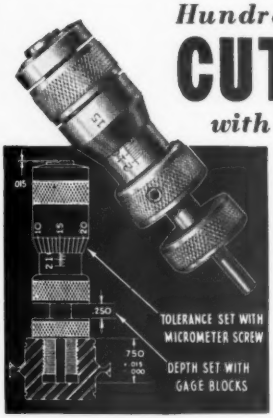

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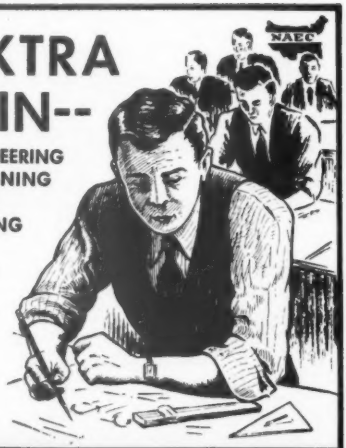

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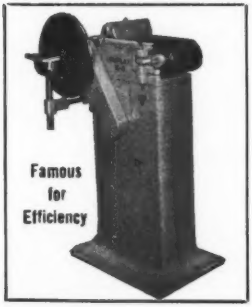

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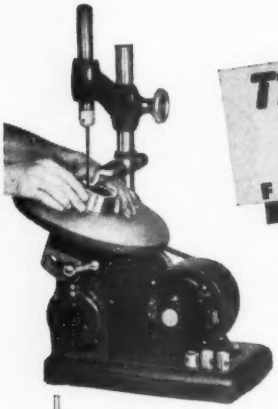

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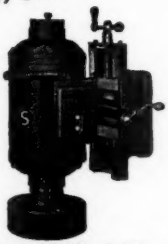

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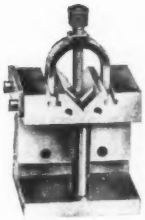

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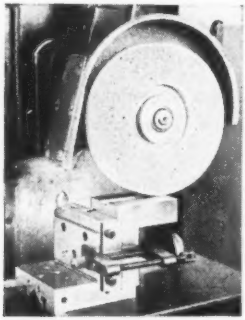

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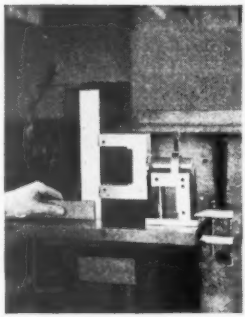

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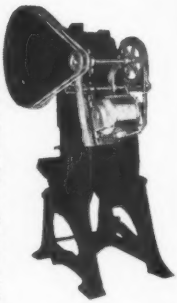

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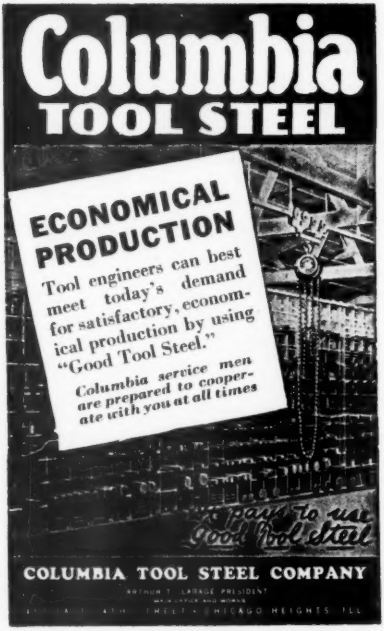
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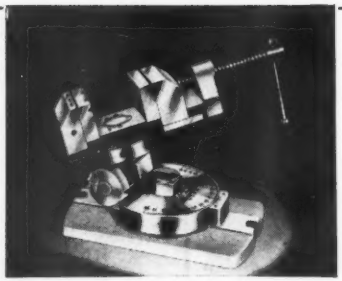

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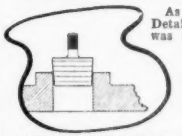

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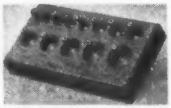

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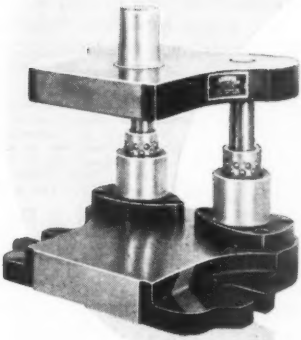

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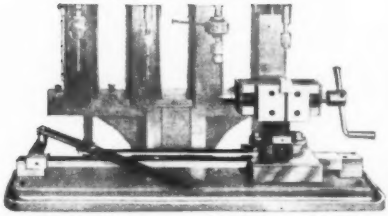

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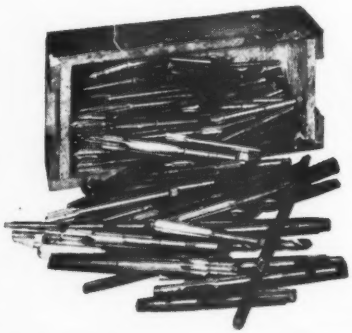

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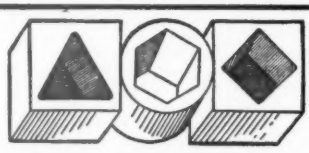

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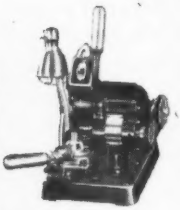

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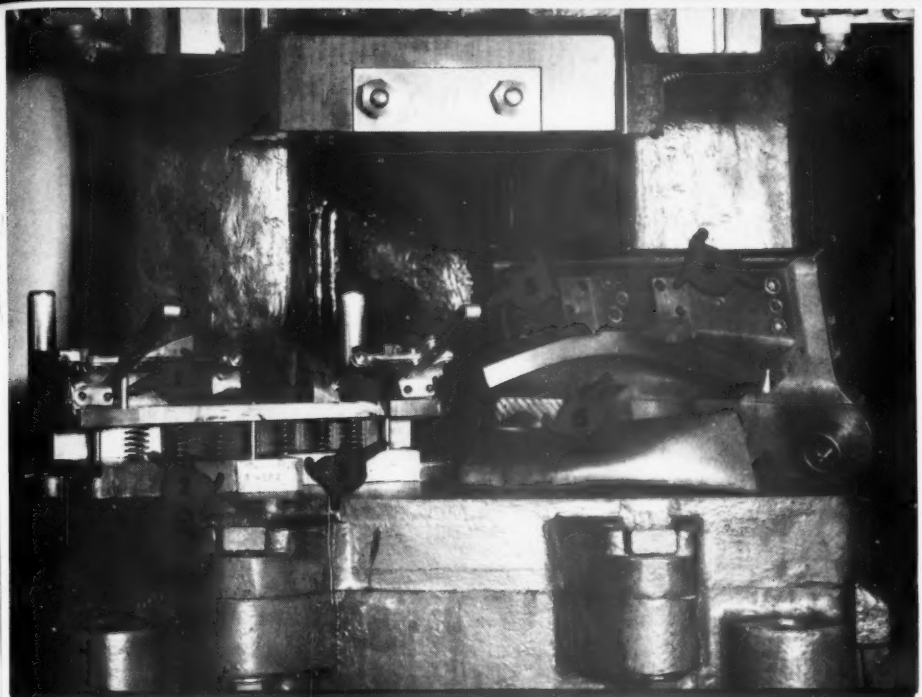

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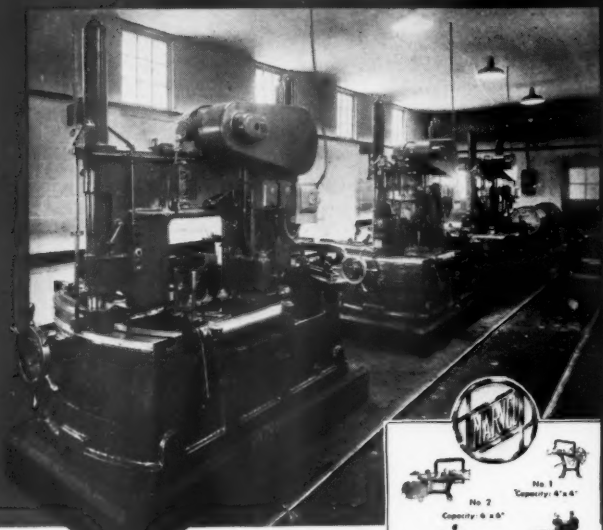

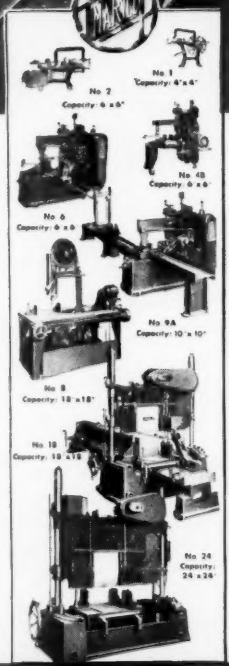

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